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Massachusetts Turnpike Authority

ANALYSIS OF THE OPERATIONS AND STRUCTURE OF THE AUTHORITY

Final Report
June 1992

KPMG Peat Marwick

Management Consultants

2001 M. Street, N.W.
Washington, DC 20036

Telephone 202 467 3000
Telex 440477 PMMDCUI

Telefax 202 223 2199

June 16, 1992

Mr. Allan R. McKinnon
Chairman
Massachusetts Turnpike Authority
10 Park Plaza, Suite 5170
Boston, Massachusetts 02116

Dear Mr. Chairman:

KPMG Peat Marwick is pleased to submit our final report, *Analysis of the Operations and Structure of the Authority*. We believe the study's finding and recommendations will reinforce the Authority's ongoing initiatives to improve efficiency and effectiveness and will help the Authority to meet evolving future requirements and challenges.

We wish to acknowledge the cooperation and extensive assistance of the Board, senior staff, and others in completing this important study.

Very truly yours,

KPMG Peat Marwick

MASSACHUSETTS TURNPIKE AUTHORITY
ANALYSIS OF THE FUTURE ROLE AND STRUCTURE OF THE AUTHORITY

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1. INTRODUCTION

There is widespread concern that our nation's declining economic competitiveness is, in part, related to our lack of investment in our existing infrastructure. There is clear evidence that the condition of our existing roads and bridges is deteriorating due, in large part, to the lack of spending for proper maintenance and rehabilitation. Adequate funds also have not been available for expanding and building new transportation facilities to serve growing and changing travel patterns.

The federal government and the states are reevaluating many strategies for addressing these issues in the transportation sector. Nationally, state governments are reviewing their fiscal and program priorities, conducting studies to "right size" agencies and programs, and seeking ways to improve efficiency and effectiveness to, in effect, increase overall transportation infrastructure investment. This comes at a time when more than half of the states face serious projected budget deficits.

The new Intermodal Surface Transportation Efficiency Act of 1991 is an important step in addressing the infrastructure problem. It dramatically changes polices and programs for meeting the nation's transportation needs. This legislation affects all the states and supports the development of toll roads and other innovative strategies, such as public-private partnerships, to help finance and meet the needs of the nation's citizens and businesses.

The Massachusetts Turnpike Authority has, for almost four decades, administered an integral part of the nation's interstate system and one of the most significant transportation systems in the Commonwealth of Massachusetts. This system today includes the Massachusetts Turnpike, a 135-mile highway which extends from the City of Boston to the western border of the Commonwealth, plus the Sumner and Callahan Tunnels under Boston Harbor which connect downtown Boston with East Boston and Logan Airport. As the central spine of the Commonwealth's surface transportation network, the MassPike system serves both commuter and intercity highway travel needs and facilitates economic activity by permitting the efficient movement of both people and goods. Funded primarily by toll-based user fees, this system has been built, operated, and maintained at a high level of service without receiving either state or federal tax dollars.

With the aging condition of its Turnpike and tunnel facilities, the Authority is faced with the challenge of financing a multimillion-dollar turnpike and tunnel reconstruction and improvement program that is vital to the continued structural integrity and safety of the system. This program is the product of the Authority's in-depth annual inspection programs and extensive planning and engineering that indicated the need to reinvest in the turnpike and tunnels infrastructure.

The Authority is also receiving increased pressures to alter or expand its fundamental mission, given the fiscal crisis confronting the Commonwealth. Already, suggestions have

been made to have the Authority perform or pay for snow plowing on other highway facilities in the Commonwealth, to use Authority toll revenues to help fund other transportation projects or programs (such as the Central Artery/Third Harbor Tunnel project), to further privatize the Authority's functions, or to consolidate the Authority into a new multiagency transportation authority.

As the Commonwealth and Authority look to the future, this study has been developed to (1) assess the efficacy of the Authority's reinvestment program which seeks to ensure that the Turnpike/tunnel system is kept in safe and efficient operating condition, and (2) provide suggestions to further improve its efficiency and effectiveness.

This introductory section of the report is presented in four sections:

- Background and evolution of the Authority
- Study purpose and objectives
- Methodology
- Considerations in the use of this report

BACKGROUND AND EVOLUTION OF THE MASSACHUSETTS TURNPIKE AUTHORITY

The Massachusetts Turnpike Authority was created by the Massachusetts Legislature in 1952 to construct, operate, and maintain a toll expressway extending from the Boston metropolitan area to the western border of the Commonwealth. The initial 123-mile section of the Massachusetts Turnpike was opened in 1957, following a two-year construction period. In 1958, the Legislature authorized the Authority to expand the MassPike system through the:

- Acquisition in 1958 of the two-lane Sumner Tunnel (first opened in 1934) from the City of Boston and construction of an adjacent two-lane Callahan Tunnel, which began operation in 1961

- Acquisition in 1962 of land from the New York Central Railroad Company and construction of the 12-mile Boston Extension, which began operation in 1965 and extended the Turnpike into the heart of Boston, connecting with the Central Artery and the Southeast Expressway

The Authority was created as a financially self-supporting entity by the Massachusetts Legislature under the user-pay concept, which has been utilized to finance and operate highways for nearly two hundred years (the earliest U.S. turnpike began in 1792). Throughout its history, the Authority has never received any state or federal tax money. The user-pay concept is based on the premise that only the users of a facility pay for its design, construction, operation, and upkeep. The user-pay concept, as applied to the

Authority through the institution of tolls, provided the Commonwealth with the following advantages:

- It provided an additional source of significant funding for specific surface transportation infrastructure without affecting the Commonwealth's budget

- It established the ability to bond future toll-based revenues, which enabled the Authority to quickly raise the initial capital needed to fund the design, land acquisition, and construction of the Turnpike and Callahan Tunnel as well as to assume responsibility for the Sumner Tunnel

- It represented a more precise mechanism for relating the specific use of the MassPike facilities to the costs associated with their acquisition, construction, operation, and maintenance

- It provided a steady and stable source of revenue, not subject to the political budgeting process, that provides sufficient funding for ongoing maintenance and improvements to safeguard the structural integrity and provide for safe operation of the road

The Authority recently completed two important assessments of the safety needs of its facilities. In January 1989, a report on the condition of the tunnels revealed the need for immediate rehabilitation of tunnel ceilings and other features of the tunnels. In 1990, the Authority also identified over $600 million in capital rehabilitation and reconstruction needs for the Turnpike to address the deterioration caused by 25 to 35 years of continuous, increasing use.

Like most states in the nation, the Commonwealth during this period has experienced a sustained economic downturn and fiscal crisis. States, in general, are experiencing a shortfall in revenues and are looking for nontax-alternatives to finance their expenditures. All types of authorities around the country are being targeted as one of those alternative sources of revenue. Other states like New York and Ohio recently examined the pros and cons of eliminating their existing turnpike authorities and have rejected the idea. The Authority's dilemma is: what is the best way to protect the traveling public's investment in the tax-free MassPike facilities so as to not jeopardize essential and safe surface transportation services, yet assist the Commonwealth in its economic development and revitalization.

STUDY PURPOSE AND OBJECTIVES

The central purpose of this study effort was to:

- Evaluate the Authority's guiding principles and policies

- Analyze the legal and operational structure of the Authority, including comparing the Authority with several generally comparable turnpikes in the Northeastern and Eastern sections of the nation

- Assess management's span of control, management levels, division of work, and organizational structure

- Assess the Authority's capital investment program and practices

The scope of our work included an evaluation of both Turnpike and Tunnel operations of the Authority.

METHODOLOGY

During the study effort, the following fact-finding, assessment, and reporting activities were conducted:

- Review of relevant data and reports concerning the legal basis, responsibilities, resources, management reports, work programs, and plans of the Authority

- Diagnostic interviews with selected Authority managers and Board members, and representatives of the financial, legal, engineering, and information systems advisors to the Authority to determine their views regarding the Authority's strengths, weaknesses, opportunities for improvement, and future roles/responsibilities/structure

- Mail survey of selected comparable turnpike, toll, and tunnel authorities in the Northeast and East to compare their organizational structure, resource levels, budget breakdowns by function, and toll schedules with the Authority's

- Review of available documentation concerning recent developments, both domestically and internationally, in the areas of toll-financing of surface transportation infrastructure and public/private partnerships

- Assessment of the Authority's:

  Guiding principles and policies
  Legal basis and organization structure
  Capital investment programs
  Use of air rights and real estate assets

- Periodic working sessions with senior managers and outside legal/financial advisors to the Authority to discuss preliminary study findings

CONSIDERATIONS IN THE USE OF THIS REPORT

This report is intended to provide insights to the executive and legislative branches of the Commonwealth, the Authority, and others regarding the efficiency and effectiveness of the Authority and the efficacy of its reconstruction and improvement program. The report presents a general overview of the Authority and its physical and functional responsibilities. This information is designed to provide the reader with a basis for evaluating the Authority's efficiency and effectivness, as well as possible organizational and operational changes.

The findings and results of this study are intended to facilitate and guide the public policy debate which has emerged in the past year regarding the future of the Authority. By considering a wide range of restructuring and privatization options and objectively assessing each relative to a wide variety of implications, the public policy debate can become more informed and productive. The result will hopefully be the development and implementation of public policy decisions regarding the future of the Massachusetts Turnpike Authority which protect and advance both the economic and surface transportation needs of the citizens and businesses of Massachusetts.

MASSACHUSETTS TURNPIKE AUTHORITY
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2. OVERVIEW OF THE AUTHORITY

To provide a basis for evaluating the Authority's current operations and for assessing its future roles and responsibilities, this section presents an overview of the Authority's:

- Authorized powers and responsibilities
- Physical characteristics and conditions of pavement and bridges
- Operating characteristics and services
- Financial structure
- Organization and staffing

AUTHORIZED POWERS AND RESPONSIBILITIES

The Massachusetts Turnpike Authority was established by Chapter 354 of the Acts of 1952 (the Turnpike Act) as a body politic and corporate and a public instrumentality of the Commonwealth. The Authority is located within, but not subject to the control of, the Department of Public Works or the Executive Office of Transportation and Construction. The Authority was created to construct, maintain, repair, and operate a toll express highway--the Massachusetts Turnpike. Pursuant to Chapter 598 of the Acts of 1958, as amended (Tunnel Act), the Authority also owns and operates the Lieutenant William F. Callahan, Jr. Tunnel and the Sumner Tunnel (the Tunnels).

The Turnpike Act. In addition to conferring certain general corporate powers (e.g., to adopt by-laws, maintain offices, sue and be sued) the Turnpike Act specifically authorizes and empowers the Authority to:

- Construct, reconstruct, maintain, repair, operate, improve, extend, or enlarge the Turnpike
- Issue Turnpike revenue bonds (and refunding bonds) for any of its corporate purposes, payable solely from tolls and revenues derived from the Turnpike and pledged for such payment, all as provided in the Act
- Fix and revise tolls
- Acquire sites adjacent to the Turnpike and construct or contract for the construction of buildings and appurtenances for gasoline stations, restaurants and other services, and lease such facilities

- Acquire by purchase or otherwise, including through the exercise of the powers of eminent domain, such public and private lands as the Authority may deem necessary for carrying out the provisions of the Turnpike Act

- Designate the location of, limit and control the points of ingress to and egress from the Turnpike

- Lease, for terms not to exceed 99 years, air rights over land owned or held by the Authority for such nonturnpike purposes as the Authority determines will not impair the construction, use, maintenance, operation, and revenues of the Turnpike, provided that any such leases for a period of more than 40 years shall be subject to the Governor's approval

The Authority is further authorized and empowered to employ consulting engineers, construction experts, accountants, lawyers, and other professionals and other employees and agents as it deems necessary; to make and enter into all contracts and agreements necessary or incidental to the performance of its duties and the execution of its powers under the Turnpike Act, and to acquire, hold and dispose of real and personal property in the exercise of its powers and performance of its duties. The Turnpike Act also empowers the Authority with incidental powers including, inter alia, the power to construct grade separations at intersections of the Turnpike with public highways; the power to change the location of portions of public highways; the power to enter lands, water and premises for purposes of examinations, surveys, drilling, etc.; the power to sell or lease any buildings or structures on any land taken by it, and the power to grant permission to any corporation or person to place and maintain pipes, wires, ducts, and similar structures on or under the Turnpike.

The Tunnel Act. The Tunnel Act confers upon the Authority powers with respect to the tunnels that parallel its powers with respect to the Turnpike. Thus, the Authority is authorized (1) to construct the Callahan Tunnel and maintain, repair, operate, and improve both the Sumner and Callahan Tunnels; (2) to acquire by purchase or otherwise, including through the exercise of the powers of eminent domain, such public and private lands as the Authority may deem necessary for carrying out the provisions of the Tunnel Act; (3) to issue Tunnel revenue bonds (and refunding bonds) for the purpose of acquiring and refinancing the Sumner Tunnel and paying the costs of the Callahan Tunnel payable solely from tolls and revenues derived from the tunnels and pledged for such payment, all as provided in the Act, and (4) to fix and revise tolls.

The Tunnel Act further authorizes and empowers the Authority to employ consulting engineers, construction experts, accountants, lawyers, and other professionals and other employees and agents as it deems necessary; to make and enter into all contracts and agreements necessary or incidental to the performance of its duties and the execution of its powers under the Tunnel Act, and to acquire, hold, and dispose of real and personal property in the exercise of its powers and performance of its duties. The Tunnel Act also

grants the Authority the same incidental powers with respect to the tunnels and allows for the transfer of assets to DPW.

PHYSICAL CHARACTERISTICS AND CONDITION OF PAVEMENT AND BRIDGES

This subsection provides a brief overview of the physical characteristics and conditions of pavement and bridges of the Authority.

Physical Characteristics

The major physical facilities of the Massachusetts Turnpike Authority include:

- Massachusetts Turnpike, a 135-mile, east-west toll highway, comprising the Initial Turnpike and its Boston Extension
- Callahan and Sumner Tunnels, parallel one-mile, two-lane tunnels under Boston Harbor that link downtown Boston to East Boston and Logan Airport

Massachusetts Turnpike

Today's 135-mile Massachusetts Turnpike was authorized and built in two phases:

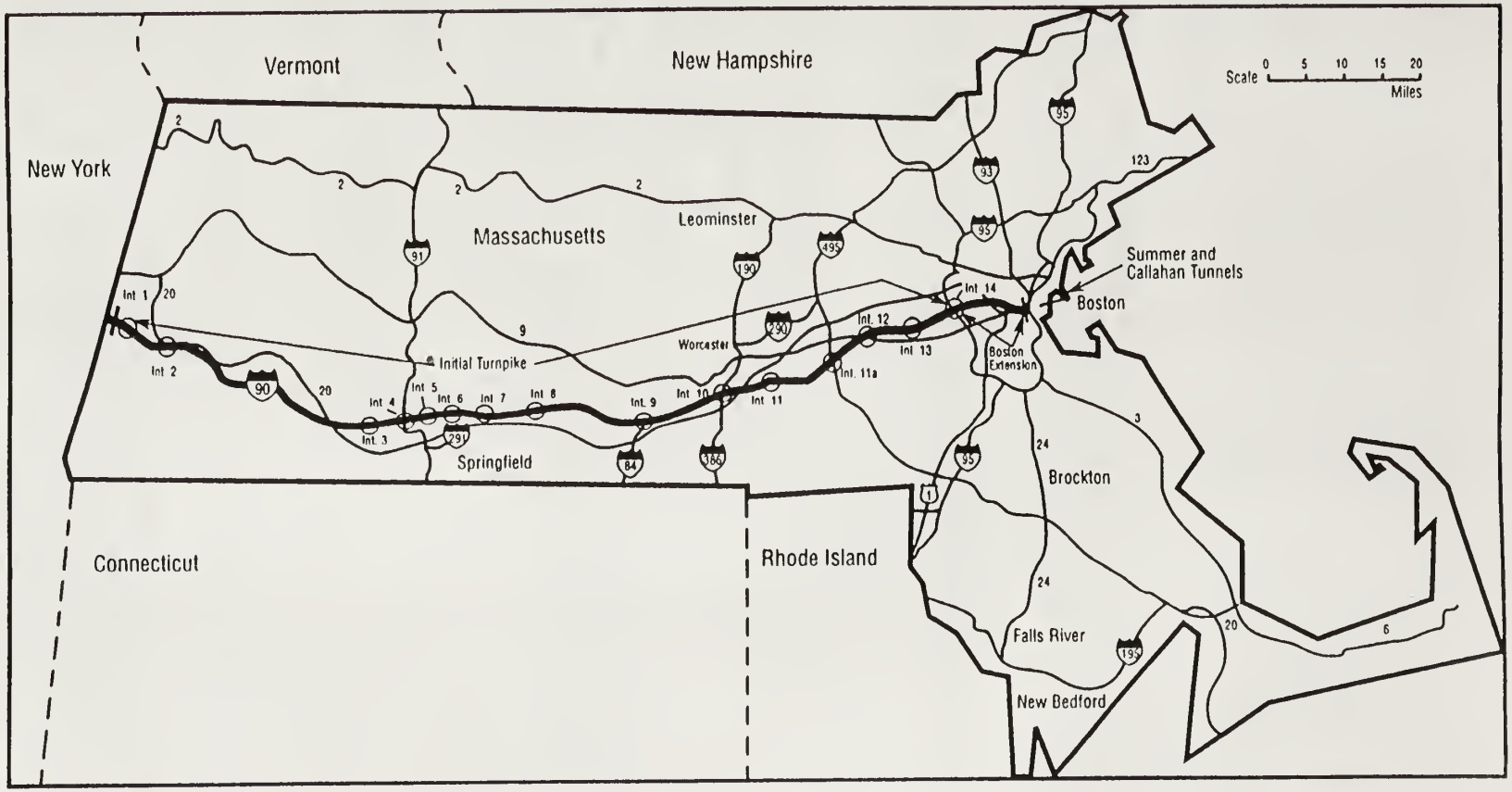
- **Initial Turnpike.** In 1957, the 123-mile, east-west toll highway was opened, extending from the Boston beltway (Route 95/128) in Weston to the western border of Massachusetts, connecting to the New York State Thruway. It was a significant engineering and construction management achievement in that it was completed in less than two years.
- **Boston Extension.** In 1965, a 12-mile extension of the Turnpike into downtown Boston was completed. Large segments of the extension are below ground level and include tunnel-like facilities supporting such air-rights development as the Copley Plaza Complex.

Both the initial Turnpike and the Boston Extension were constructed and are operated and maintained without federal or state tax money. Because both major sections of the Massachusetts Turnpike are significantly different as to where and how they were constructed, they have significantly different physical attributes. Exhibit 2-1 illustrates the entire Turnpike and Tunnels.

Descriptions of the physical attributes of the two Turnpike sections follow.

Massachusetts Turnpike Tunnels

EXHIBIT 2-1



Initial Turnpike. The initial section of the Turnpike extends from the New York stateline to Weston. It is generally rural in nature in the western and central parts providing access to cities like Springfield, Chicopee, and Ludlow. In the west it begins at the New York State border (connecting to the New York State Thruway), passes through the Berkshire Mountains, the Connecticut Valley, and ends in the Boston suburbs at Interstate 95/Route 128. Along the way, the Turnpike goes through 32 cities and towns and crosses or intersects Interstates 91, 84, 395, 495, 93, and 95. Other key physical features of the Initial Turnpike include:

- **Convenience, comfort, and safety facilities.** The Initial Turnpike has 15 interchanges, 9 food and 11 fuel service areas, 6 maintenance depots, and a State Police headquarters and two barracks for the administration of the State Police patrols that monitor and enforce safety on the entire roadway.

- **Engineering and design standards.** The Initial Turnpike is designed for safety and superior surface transportation travel with:

  15 interchanges
  45 miles of six-lane divided highway
  78 miles of four-lane divided highway
  180 bridges with a clearance of 14´3˝ or more
  300-foot right of ways
  Maximum ascend grade restricted to 3.5 percent

Boston Extension. The Boston Extension continues the Turnpike from Weston east to downtown Boston. It includes a passageway, or tunnel, under the city complex commonly referred to as the Prudential Center and Copley Place. Other key physical features of the Boston Extension include:

  10 interchanges
  12 miles of divided highway
  80 bridges to carry traffic over the expressway
  12-foot travel lanes
  Intermittent turnout lanes

Sumner and Callahan Tunnels

The Authority operates and maintains the Sumner and Callahan Tunnels, two parallel, approximately 1-mile long tunnels under Boston Harbor that link downtown Boston to East Boston and Logan Airport. In 1958, the Legislature authorized the Authority to acquire the Sumner Tunnel from the City of Boston and to construct the Callahan Tunnel parallel to it.

In 1959, the Authority purchased the then 25-year-old Sumner Tunnel and began construction of the Callahan Tunnel. The Callahan Tunnel began operation in 1961. The

Sumner Tunnel was subsequently renovated and reopened to traffic in 1962. Together the Tunnels provide a four-lane facility joining the Central Artery (I-93) and the street system of Boston with the McClellan Highway (Route 1A) and Logan Airport.

Physical characteristics of Tunnels. The Sumner and Callahan Tunnels are similar in many ways and unique in a few, including:

- Sumner opened in 1934 while the Callahan opened 26 years later in 1961
- Both were built by the shield method
- Both are two-lane tunnels
- Sumner is 803 feet longer between portals than the Callahan
- Both are lighted by continuous lines of fluorescent lamps mounted just below the ceiling that are being replaced as part of the removal and replacement of ceramic and concrete ceilings

Toll collection facilities. All toll booths are located in East Boston. The toll plaza is configured with eight booths and eight traffic lanes.

Ventilation buildings. Both Tunnels are ventilated by buildings located at their four respective portals. These buildings contain the electrical power supply equipment and large tunnel fans necessary to maintain an environmentally safe air quality in the Tunnels.

Other facilities. Other facilities related to the Tunnels include:

- The Tunnel Administration Building, built in 1962, is located next to the toll collection facilities. This building incorporates the East Boston garage facility.
- The old Sumner Tunnel Administration Building is located near the Boston end of the Sumner Tunnel, and is used for housing emergency equipment for servicing the tunnel.
- The East Boston Garage and Toll Building is located in East Boston across the toll plaza from the Tunnel Administration Building and houses tunnel-related State Police personnel and emergency service equipment.

Physical condition

This subsection provides an overview of the physical condition of the Authority's key infrastructure components in the following order:

- Turnpike pavement conditions

- Turnpike bridge conditions

  Initial Turnpike
  Boston Extension

- Sumner Tunnel and Callahan Tunnel conditions

Turnpike pavement conditions

The 135 miles of Massachusetts Turnpike has 676 lane miles of pavement and over 1,100 lane miles of pavements, shoulder lanes, ramps, etc. The Turnpike's pavements continually deteriorate due to:

- High traffic volumes (over 2.2 billion annual vehicle miles)
- Heavy truckloads
- Weather conditions (frequent freeze-thaw cycles)
- Road salts used during inclement winter weather
- General aging (25 to 35 years)

These conditions, over time, cause pot holes, swales, and in general, create a poor pavement surface. A poor pavement surface causes unsafe operating conditions by making snow and ice removal difficult, increases hydroplaning, and causes excessive wear on vehicles. The Authority's experience shows that a pavement surface made from a good quality bituminous overlay lasts, at a maximum, 12 to 15 years. Therefore, an operational rule-of-thumb is that any pavement surface older than 11 years is a candidate for resurfacing if the roadway is to be maintained in a safe operating condition.

Exhibit 2-2 shows the Turnpike pavement conditions (as illustrated by age of the pavement) for the years 1985 and 1991, respectively. This summary indicates that:

- In 1985, none of the roadway was classified in the "over 15 years old" category, yet in 1991, 23 miles or 17 percent of the Turnpike falls into this category

- 1991's 23 miles of Turnpike pavement "over 15 years old" appears to be the result of the continued "aging" of the large amount of 11-15 year old pavement that existed in 1985 (53 miles or 39 percent of all Turnpike miles)

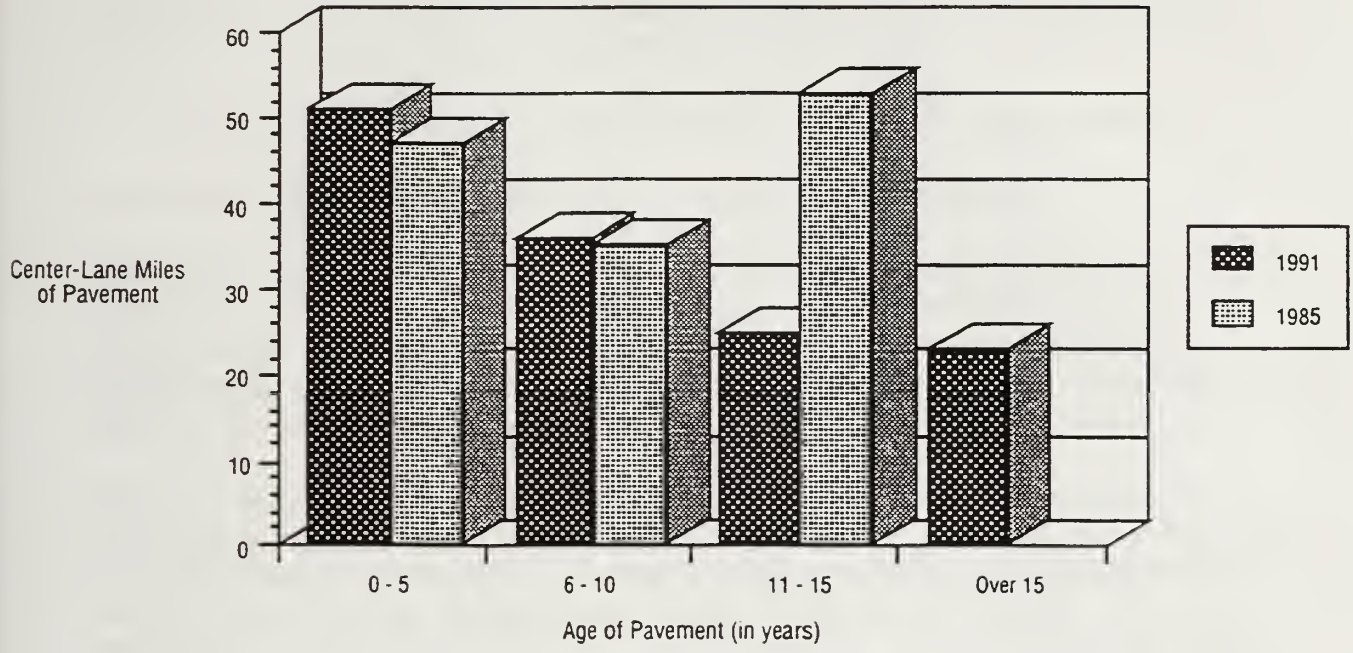
The Authority's management recognizes the need to resurface old pavements. The Authority's goal is to resurface at the rate of 10 miles a year. Unfortunately, this type of schedule was not maintained prior to 1987. Given the 36 percent of Turnpike miles that already are "over 10 years old," the current program focuses on the most urgent needs.

To address all of its resurfacing needs and work off its resurfacing backlog in the "over 15 years old" category will take approximately four years, at the current pace. Costs and

Age of Pavement Comparison: 1985 Compared With 1991

EXHIBIT 2-2

The average life of a pavement surface is 10 years; older pavement is a candidate for resurfacing.



Note: In 1985, there were no center-line miles that were over 15 years in age.

Year	Total Center-Line Miles	Age Category			
		Over 15 Years	11-15 Years	6-10 Years	0-5 Years
1985	135	0	53	35	47
Percentage of Total	100%	0%	39%	26%	35%
1991	135	23	25	36	51
Percentage of Total	100%	17%	19%	27%	38%

the current lack of funding prevent management from resolving this backlog more quickly.

The cost of resurfacing one mile of roadway is approximately $600,000. That means $6 million of funding is needed annually in order to maintain balance in the Turnpike's pavement resurfacing program and allow a 10-mile-per-year pace. The current 1992 budget for pavement resurfacing is $6 million.

Turnpike bridge conditions

In evaluating of the condition of the Turnpike bridges it is useful to separate the 260 bridges that the Authority owns and maintains into two groups:

- 180 bridges built during 1957 to 1958 that are located on the Initial Turnpike
- 80 bridges built during 1962 to 1965 that span the Boston Extension

The Authority's bridges are 25 to 35 years old, and many are approaching the age where significant deterioration has occurred and will accelerate if reconstruction and improvement efforts are not undertaken. The Authority's turnpike bond covenant requires bridge rehabilitation and reconstruction to be funded on a pay-as-you-go basis. These covenants have restricted the Authority's ability to finance such repairs in a timely manner.

Bridges experience significant deterioration due to the same causes as pavement deterioration (weather, traffic, trucks, etc.). Deteriorated bridges can be shielded (screened to prevent pieces of the bridge from falling on passing vehicles) or weight-restricted (causing heavier vehicles to be rerouted) to prolong their operation before they must be rehabilitated, reconstructed, or closed. A weight-restricted bridge on the Massachusetts Turnpike would cause detours and delays for motorists and motor carriers. The Turnpike has never had a weight-restricted bridge.

The life of a bridge is generally extended through two types of rehabilitation:

- *Bridge deck repair* is the removal and replacement of only the top four inches of concrete and top layer of reinforcing steel. This is usually performed on bridges that do not require deck replacement.
- *Bridge deck replacement* is the complete removal of the existing reinforced concrete and construction of a new reinforced concrete deck. This is typically performed near the end of the original life span of the bridge deck (i.e., 30-40 years).

As with pavement, greater emphasis has been placed since 1988 on rehabilitating the Authority's bridges. This can be demonstrated by contrasting the condition of the bridges in past years to their current status. The condition ratings for Turnpike bridges used in this

section were supplied by the Turnpike's general consultants and were developed using Federal Highway Administration bridge ratings procedures.

Bridge conditions on the Initial Turnpike. Exhibit 2-3 on the following page illustrates the bridge deck condition ratings of the Initial Turnpike for the years 1985 and 1987-91. The key implications of the bridge condition data are:

- There has been a 25 percent increase (16 bridges from 1985 to 1991) in the percentage of bridges rated "generally good, good, and new." This has resulted from the Authority implementing some of its critical needs initiatives. Bridge deck replacements were performed instead of infrastructure preservation bridge deck repairs as this was deemed the most cost effective long-term strategy.

- There has been a 35 percent decrease in the "fair and generally fair" ratings and a 50 percent increase in the "marginal, poor, and critical" ratings. This escalation in "marginal, poor, and critical" ratings results from the accelerated deterioration that occurs near the end of a bridge's design life.

Bridge conditions on the Boston Extension. Exhibit 2-4 shows the bridge condition ratings of the Boston Extension for year 1985 and 1987-1991.

EXHIBIT 2-4

Boston Extension Bridge Condition
Number of Bridges by Rating per Year

Bridge Rating Deck-Condition Below	'85	'87	'88	'89	'90	'91
Marginal, poor, and critical	8	14	15	16	14	15
Fair and generally fair	36	27	26	26	28	27
Generally good, good, and new	5	12	13	13	12	13
Under repair/other	31	27	26	25	26	25
Total Boston Extension bridges	80	80	80	80	80	80

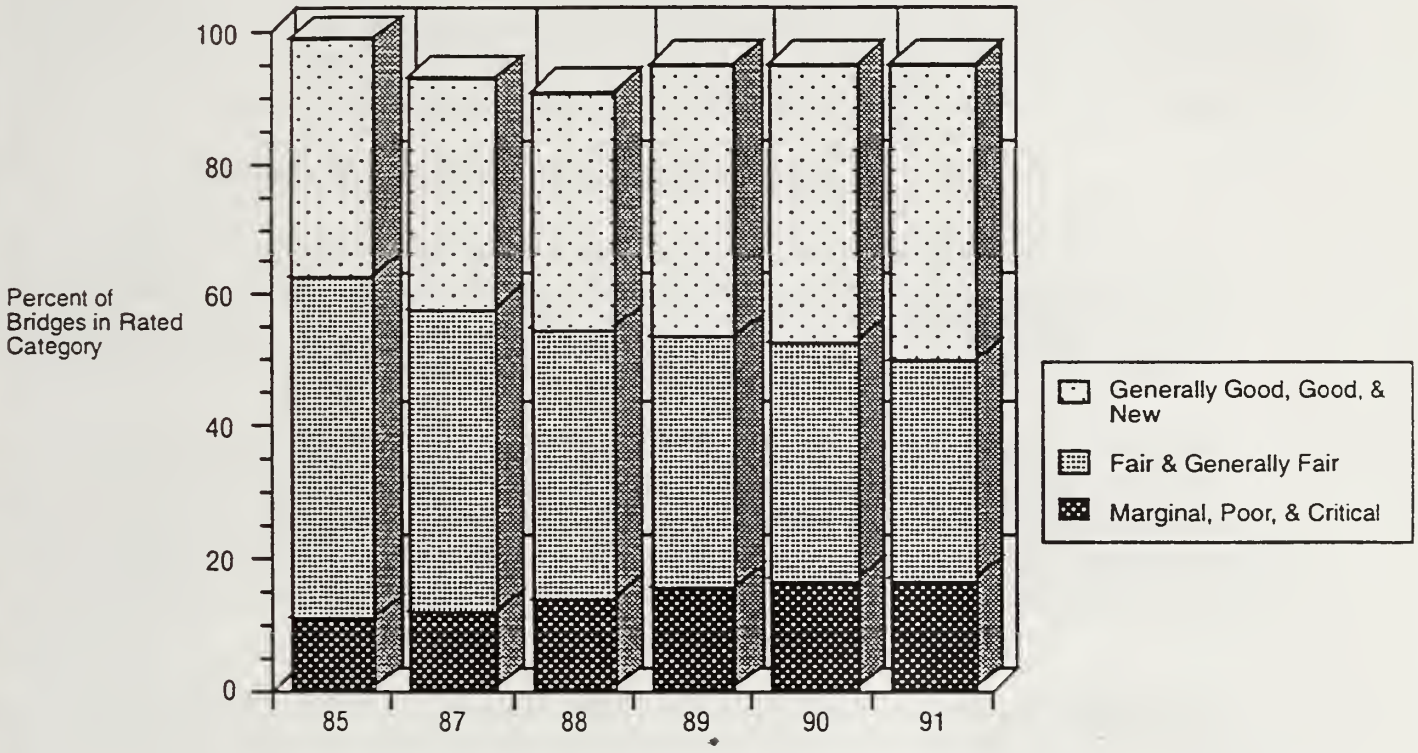
The above data indicates that:

- Between 1985 and 1987, the number of Boston Extension bridges in the marginal, poor, and critical category almost doubled, as this portion of the Turnpike reached the 25-year age level.

Initial Turnpike Bridges: Bridge Deck Condition

EXHIBIT 2-3

The Stacked Bar Graph illustrates the percentage of rated bridges by category and year based on the inspection of the bridge deck below the surface (exclusive of bridges not rated).



Bridge Deck - Below Condition Category	Year					
	1985	1987	1988	1989	1990	1991
Marginal, Poor, & Critical	20	21	26	28	31	30
Percent of Total	11%	12%	14%	16%	17%	17%
Fair & Generally Fair	93	82	74	69	65	60
Percent of Total	52%	46%	41%	38%	36%	33%
Generally Good, Good, & New	65	63	65	74	75	81
Percent of Total	36%	35%	36%	41%	42%	45%

- Between 1985 and 1987, the number of Boston Extension bridges in the generally good, good, and new category more than doubled, due to the completion of a number of bridge rehabilitation projects.

- Between 1987 and 1991, the relative condition of the Boston Extension bridges has remained stable as the Authority's bridge rehabilitation and reconstruction program has kept pace with the deterioration of these aging facilities.

During the past 15 years, a third of the bridge decks on the Initial Turnpike have been replaced and a quarter of those on the Boston Extension have been repaired. *The Authority's pace of reconstruction will need to increase in the future if the critical needs of the remaining Turnpike bridges are to be reconstructed by the end of their design life.* This can occur only if the Authority increases its revenues or refinances its Turnpike bonds.

Condition of the Sumner and Callahan Tunnels

In 1988, the Authority undertook a comprehensive evaluation of the condition of the Tunnels after the 1987 annual inspections revealed a continuing and escalating rate of deterioration. The evaluation report, dated January 1989, detailed and estimated a Comprehensive Repair and Rehabilitation Program of $58 million (in 1989 dollars).

Subsequent to that engineering report, inspections of the Sumner Tunnel found that numerous hanger bars that supported the concrete ceiling slab were broken or cracked. Emergency repairs were undertaken to restore the safety and clearance of the Sumner Tunnel's sagging concrete ceiling. At the same time, Callahan Tunnel ceiling tiles were in such a state of deterioration that they were falling on vehicles at a rate of once every six weeks.

The Authority, based on in-depth inspection reports from its consulting engineer and continued incidents of falling ceiling tiles in the Callahan Tunnel, borrowed $47 million (through the Massachusetts Industrial Finance Agency issuance of long-term revenue bonds) in 1990 to finance an essential portion of its comprehensive repair and rehabilitation program. This emergency financing was arranged to address serious safety problems in the tunnels. This four-year capital program consisted of the following major projects:

- **Ceiling removal and replacement**. Both the Sumner and Callahan Tunnels are having their complete ceiling and roadway lighting systems replaced. The concrete ceilings are being replaced with a stronger yet lighter ceiling that meets all the functional needs and increases the clearance height of the Tunnels to be compatible with the Central Artery/Third Harbor Tunnel (CATHT). The obsolete and deteriorated lighting systems attached to the ceilings are being replaced with a more efficient and effective lighting system.

- **Roadway repairs**. Both the Sumner and Callahan Tunnels are undergoing repairs to the underside of their deteriorated roadway slab.

- **Callahan Tunnel bench walls and railing repair**. The bench walls, or the lower portion of the Callahan Tunnel walls, will be rebuilt. Polymer concrete panels that will withstand vehicle impacts will replace the tiles currently in the tunnel.

Other aspects of the program include repairs to the Tunnels' liner plates and rings, rehabilitation of roofs and walls of the Tunnels' ventilation buildings, and their electrical equipment, asbestos removal as required, replacement of the elevators in the Sumner Tunnel ventilation buildings, and rehabilitation of the elevators in the Callahan Tunnel ventilation buildings.

A number of other important repair and rehabilitation projects have been identified but are *not currently funded* by the current borrowing. Some of these unfunded projects include:

- Resurfacing the pavement of the Callahan Tunnel

- Replacement of Sumner Tunnel ventilation equipment

- Repairs to the fresh air ducts for both tunnels

- Construction of permanent toll booths to replace the temporary ones

It is anticipated that currently funded tunnel projects will be completed during 1994; the other tunnel projects are contingent on future bond financing.

OPERATING CHARACTERISTICS AND SERVICES

This subsection provides a brief overview of selected operating characteristics of the Authority. It is presented as follows.

- **Traffic and tolls**. An overview of the history of transaction growth and toll rates for the Turnpike and Tunnels.

- **Safety**. An overview of the safety record of the Turnpike relative to other comparable turnpikes, as well as roads in Massachusetts and the United States at large.

- **Other services**. A summary of the various services provided by the Authority that directly benefit people who use its facilities and the neighboring communities.

Traffic and Tolls

In this section we present the traffic transactions and toll schedules for the MassPike facilities. They are presented in the following order:

- Turnpike traffic and tolls
- Tunnel traffic and tolls

Turnpike traffic and tolls

In its first year of operations, the Massachusetts Turnpike handled almost 11 million transactions. In 1991, the annual transaction count was approximately 130 million. A large portion of this growth is attributable to the Boston Extension, as shown in Exhibit 2-5. The table shows the average compound annual growth rate through 1966 was 23 percent. Although subsequent growth was less dramatic from 1966 through 1982, it grew at an average compound annual rate of 4 percent. In the last nine years, it has experienced only a 2 percent average compound growth rate.

Among the few years in which the Authority experienced no growth or negative growth in transactions were 1990 and 1991. This negative growth appears to be primarily the result of the economic recession affecting the Northeast, although the Turnpike toll increase in 1990 may have contributed somewhat to this result. As shown in the exhibit, negative growth also occurred in 1980 and 1974--both recessionary periods with energy shortages and higher gas prices.

Toll schedules have been changed only three times in the history of the Turnpike. A history of steady traffic growth is one of the reasons why toll rates have remained modest for so long. Exhibit 2-6 illustrates that turnpike tolls have not kept pace with inflation. It compares the original 1957 passenger vehicle toll rate (for the entire length of the Initial Turnpike) to an indexed toll rate which is computed based on the national Consumer Price Index between 1957 and 1990.

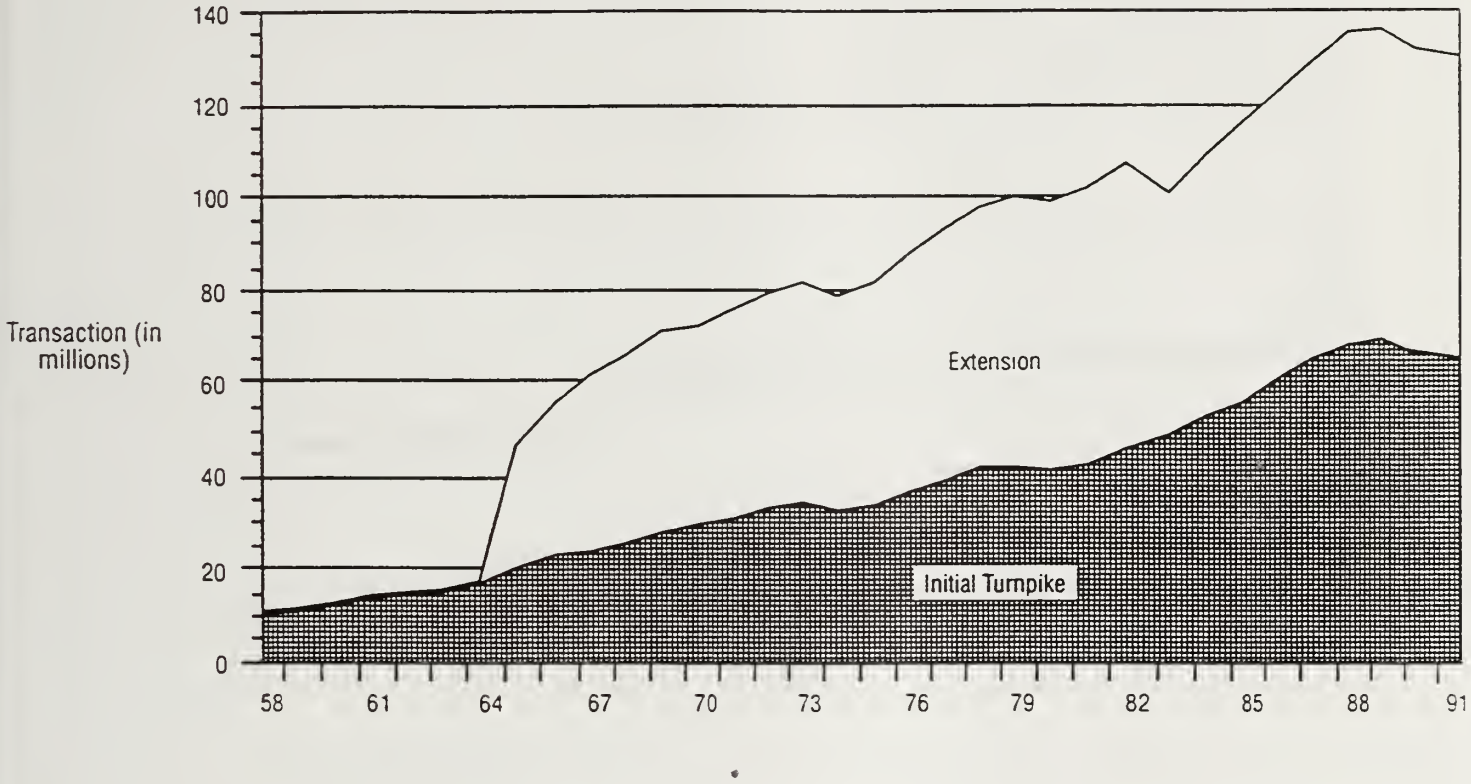
Tunnel traffic and tolls

The tunnels have historically demonstrated less growth in transactions than the Turnpike. Exhibit 2-7 depicts the historical Sumner and Callahan transaction volumes taken from the tunnel traffic engineer's report. The exhibit illustrates an average annual growth rate in transactions of one percent for the period of 1983 through 1991. Tunnel transaction volume has decreased in the last two years.

In August 1989, new toll schedules were implemented on the MassPike tunnels. The cost of crossing Boston Harbor via the tunnels is now $.50 one-way or $1.00 per round trip. The tunnels are significantly less expensive when compared to other toll tunnel and bridges in urban centers. Exhibit 2-8 shows the effective toll rates of other selected tunnels and bridges in major urban areas of the Northeast.

Turnpike Transaction and Traffic Growth

EXHIBIT 2-5

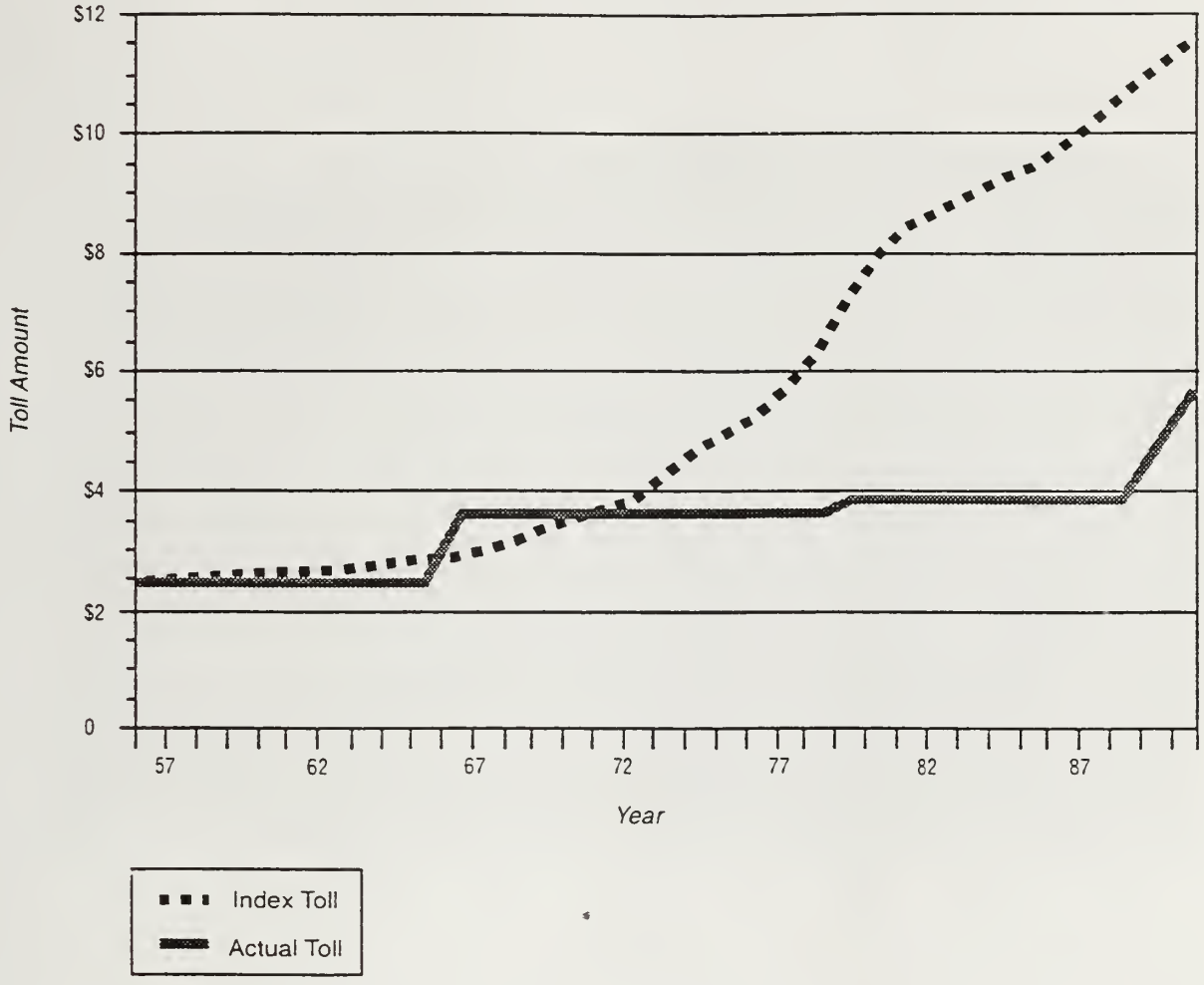


Turnpike Section	Annual Transactions Volume (in millions)				
	1958	1966	1974	1982	1991
Initial Turnpike	10.9	23.5	32.7	45.9	67.1
Boston Extension		33.4	46.1	62	62.4
Total Turnpike	10.9	56.9	78.8	107.9	129.5
Percentage Growth*		23%	4%	4%	2%

** Shows average compound annual growth since preceding period.*

Comparison of Turnpike Toll Schedules for Passager Vehicles and The Consumer Price Index

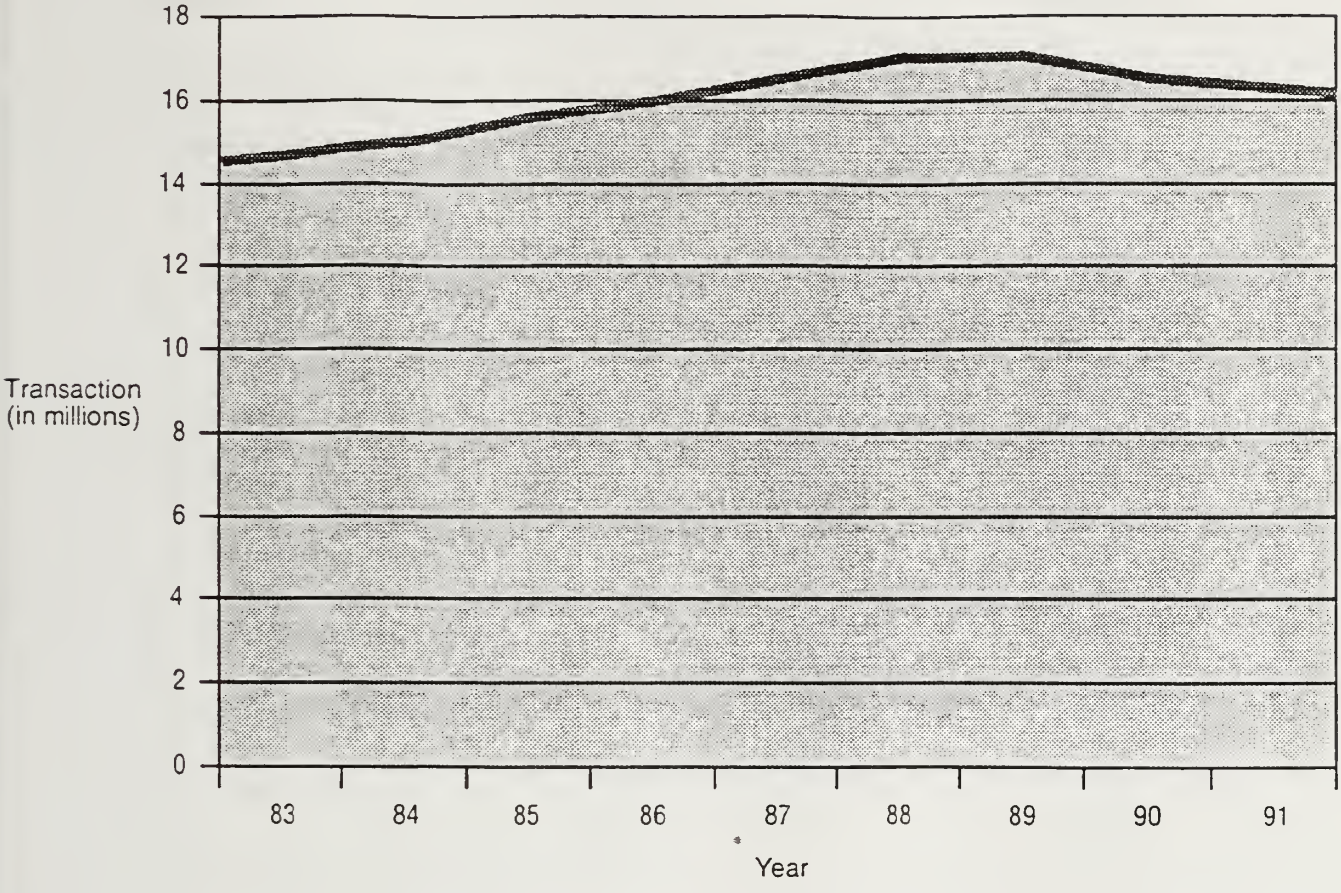
EXHIBIT 2-6



Sumner and Callahan Tunnels

EXHIBIT 2-7

TRANSACTION GROWTH



	Year				
	1983	1985	1987	1989	1991
Annual Transactions (in millions)	14.7	15.7	16.5	16.7	16.1
Percentage Growth		3.2%	2.4%	0.8%	-1.7%

PASSENGER CAR TOLL COMPARISONS FOR NORTHEAST TUNNELS AND MAJOR URBAN BRIDGE CROSSINGS

EXHIBIT 2-8

Facility	Round Trip Fare 1991
Tobin Bridge (Boston)	$0.50
Peace Bridge (Buffalo)	1.00
Sumner/Callahan Tunnels (Boston)	**1.00**
Delaware Memorial Bridge (Wilmington)	1.50
Barry Bridge (Philadelphia)	1.80
Ben Franklin Bridge (Philadelphia)	1.80
Baltimore Harbor Tunnel	2.00
Ambassador Bridge (Detroit)	2.50
Cross Bay Bridge (New York)	2.50
Henry Hudson Bridge (New York)	2.50
Marine Parkway Bridge (New York)	2.50
Tappan Zee Bridge (New York)	2.50
Windsor Tunnel (Detroit)	3.00
Bayonne Bridge (New York)	4.00
George Washington Bridge (New York)	4.00
Goethals Bridge (New York)	4.00
Holland Tunnel (New York)	4.00
Lincoln Tunnel (New York)	4.00
Outerbridge Crossing (New York)	4.00
Bronx-Whitestone Bridge (New York)	5.00
Brooklyn-Battery Tunnel (New York)	5.00
Queens-Midtown Tunnel (New York)	5.00
Throg's Neck Bridge (New York)	5.00
Triboro Bridge (New York)	5.00
Verrazano Narrows Bridge (New York)	5.00

Source: International Bridge, Tunnel, and Turnpike Association

Safety

Safety of the millions of motorists who depend on the Turnpike and Tunnels is the Authority's stated "number one priority." The Authority has achieved an outstanding safety record in comparison with other roads in Massachusetts and the nation and other major toll roads.

As shown in Exhibit 2-9, the national average for "fatalities per 100 million vehicle miles" was 2.16 in 1989. For the same year, the Authority fatality rate was 0.3. The Authority's record is no less impressive when compared to other roads in Massachusetts or other sizable turnpikes (over a billion vehicle miles annually).

MassPike achieved a high level of safety when compared to a sample of similar toll road facilities. This is illustrated in Exhibit 2-10.

Other services

To promote the safety of and to provide useful services to the millions of motorists who travel the Turnpike and Tunnels, the Authority provides the customer services described next.

State Police Troop E

Police are assigned to and funded solely by the Authority. Troop E enforces traffic and safety regulations, responds to highway accidents, aids stranded motorists, and ensures public safety. In 1990, they issued 70,000 citations for motor vehicle violations and made over 200 DUI arrests. Twenty percent of all fines for infractions on the Turnpike and the Tunnels go to the local jurisdiction. Troop E has special units which enforce motor carrier compliance with weight restrictions and safety requirements for their vehicles. Other units, equipped with unmarked cars and radar, patrol the road to ensure compliance with speed limits and safe driving behavior.

Emergency Service Patrol

The Turnpike is continuously patrolled by trucks that help motorists with disabled vehicles. The Emergency Services Patrol supply stranded motorists with fuel, help change flat tires, and start stalled vehicles. The patrols also assist State Police and Authority maintenance crews by helping to clean up broken glass and other debris at accident sites. The patrols logged over 785,000 miles and helped over 25,000 patrons during the past year.

Food Service

The Turnpike has entered into an agreement with the Marriott Corporation to provide food services at nine different locations along the Initial Turnpike. The Marriott agreement

EXHIBIT 2-9

Massachusetts Turnpike Authority Comparative Safety Record (fatalities per 100 million vehicle miles)

Year	MassPike[1]	Avg. Large Turnpikes[2]	Massachusetts[3]	United States[3]
79	1.10	1.40	2.62	3.34
80	1.00	1.30	2.49	3.36
81	0.90	1.00	2.49	3.18
82	1.00	1.40	1.79	2.75
83	0.50	0.80	1.73	2.58
84	0.70	1.30	1.73	2.58
85	0.40	1.10	1.86	2.47
86	0.30	0.80	1.84	2.51
87	0.60	1.00	1.63	2.41
88	0.60	1.00	1.67	2.32
89	0.30	0.80	1.51	2.16

Source:
(1) IBTTA, Turnpike Accident and Fatality Report
(2) IBTTA, Turnpike Accident and Fatality Report for Toll Roads > a billion vehicle-miles (including Massachusetts)
(3) Highway Statistics, Motor Vehicle Traffic Fatalities and Injuries, Table FI-1

EXHIBIT 2-10

Comparative Turnpike Nonfatal Accident Statistics (nonfatal accidents per 100 million vehicle miles)

Type of Accident	Mass Turnpike	Garden State Park-way	NJ Turnpike	NY Thruway	Ohio Turnpike	Penn Turnpike
Property Damage	59	59	95	72	66	84
Personal Injury	13	33	33	22	18	18
Total	72	92	128	94	84	102

Source: KPMG Peat Marwick Turnpike Survey, December 1991

allows travelers to patronize a variety of fast food options (Burger King, Sbarro, Roy Rogers, Taco Bell, TCBY Yogurt).

Gasoline Service Stations

Mobil Oil Corporation operates 11 service stations along the Initial Turnpike. In 1990, the Authority executed a new agreement with Mobil. In the first week of the new agreement, prices were reduced by as much as 18 cents a gallon at the service stations.

Tourist Information Centers

A major goal of the Authority is to promote tourism and economic activity along the turnpike corridor. In support of this objective, the Authority operates four tourist information centers on the Turnpike. These facilities were previously operated and paid for by the Commonwealth's Office of Tourism. In 1989, the Authority assumed full financial and operational responsibility for the information centers. The centers offer brochures, vacation guides, free maps, and advice on travel and lodging in the Commonwealth.

Good Neighbor Actions

The Authority typically lends a helping hand to communities and the Commonwealth without receiving compensation. Examples in recent years include:

- Provided $2.8 million for DPW's Route 146 project
- Implemented a $5 million noise barrier pilot program
- Performed traffic studies in Palmer and West Stockbridge to assess impacts of Authority traffic on local roads
- Helped with cleanup efforts following a series of natural disasters in 1991, including Hurricane Bob, which included tree removal and other necessary actions to help Cape Cod communities recover from the storm
- Assisted the City of Chelsea by performing an audit and analysis of its motorized equipment and related facility buildings
- Contributed $4.5 million in 1990-91 for maintenance of the Central Artery
- Contributed $770,000 to the Commonwealth for Central Artery maintenance in lieu of participating in the Commonwealth's employee furlough program

FINANCIAL CHARACTERISTICS

The Massachusetts Turnpike Authority is a not-for-profit organization. It operates the Turnpike and the Tunnels as separate cost and revenue centers, each governed by an Enabling Act and corresponding Trust Agreement. The Trust Agreement is a contract with the bondholders specifying the manner in which the Authority cost center revenues may be administered.

Authority Turnpike and Tunnel revenues by source for 1991 are:

	Turnpike	Tunnels	Total
Toll Revenue	$123.4	$15.7	$139.1
Restaurant Concession	2.7	0.1	2.8
Service Station	1.8	0.0	1.8
Rental Income	2.9	0.0	2.9
Investment Income:			
Restricted Fund	3.0	1.2	4.2
Revenue Fund	.9	0.0	.9
Total	$134.7	$17.0	$157.1

The Authority's three major sources of revenue for 1991 were:

- **Tolls.** This source accounts for 92 percent of the Authority's total revenue. In 1991, toll revenues were $139.1 million. Turnpike tolls represent 89 percent of the total toll revenue, with Tunnel tolls representing about 11 percent. Because the Turnpike and Tunnels operate as legally separate cost centers, revenues brought in through each facility must be expended only on that facility.

- **Concession, rents, and other.** This source accounts for 5 percent, $7.5 million, of 1991 revenue.

- **Investments.** Investment income was $5.1 million or 3 percent of 1991 total revenue. The majority of investment income is restricted in that the use of investment income is pledged to debt service payments and reserve requirements. Only a small portion of total revenue, less than 1 percent, represents investment income on funds deriving from ongoing Authority operations.

Other potential revenue sources for the Authority include:

- **Proceeds from the sale of bonds.** Funds, if any, are generally not considered "revenue" as they represent borrowed funds that are restricted to specific capital projects.

- **Federal aid.** Under the new federal policy, the Authority is eligible for an allocation of federal funds that will be given to the Commonwealth.

Exhibit 2-11 provides a historic picture of the relative toll revenue contributions of the Initial Turnpike and the Boston Extension.

There are three major uses of Authority revenue, as shown in Exhibit 2-12:

- **Operating expense.** This expense category accounts for approximately 45 percent of total authority expenditures. The expense category includes payroll, materials, operating expense reserves and supplies needed to carry out administration, operations, and normal maintenance of the Authority's facilities. It also includes the cost for the state police that patrol the highway.

- **Capital spending**. Funds that are used for resurfacing, replacement or reconstruction, unusual repairs, or extraordinary maintenance. This accounts for approximately 30 percent of the annual expenditures. Such expenditures must be funded on a pay-as-you-go basis in accordance with Authority bond indentures which are high restrictive.

- **Debt service.** Bond debt service accounts for approximately 25 percent of the Authority expenditures. Funds not used for operations and replacement reserves are applied to the redemption of outstanding revenue bonds.

The capital project funds generated from revenue bond proceeds are allocated to approved construction projects and accounted for in the construction fund. The bonds constitute a special obligation of the Massachusetts Turnpike Authority. Revenues of the Turnpike and tunnels are pledged separately and therefore administered separately.

ORGANIZATION AND STAFFING

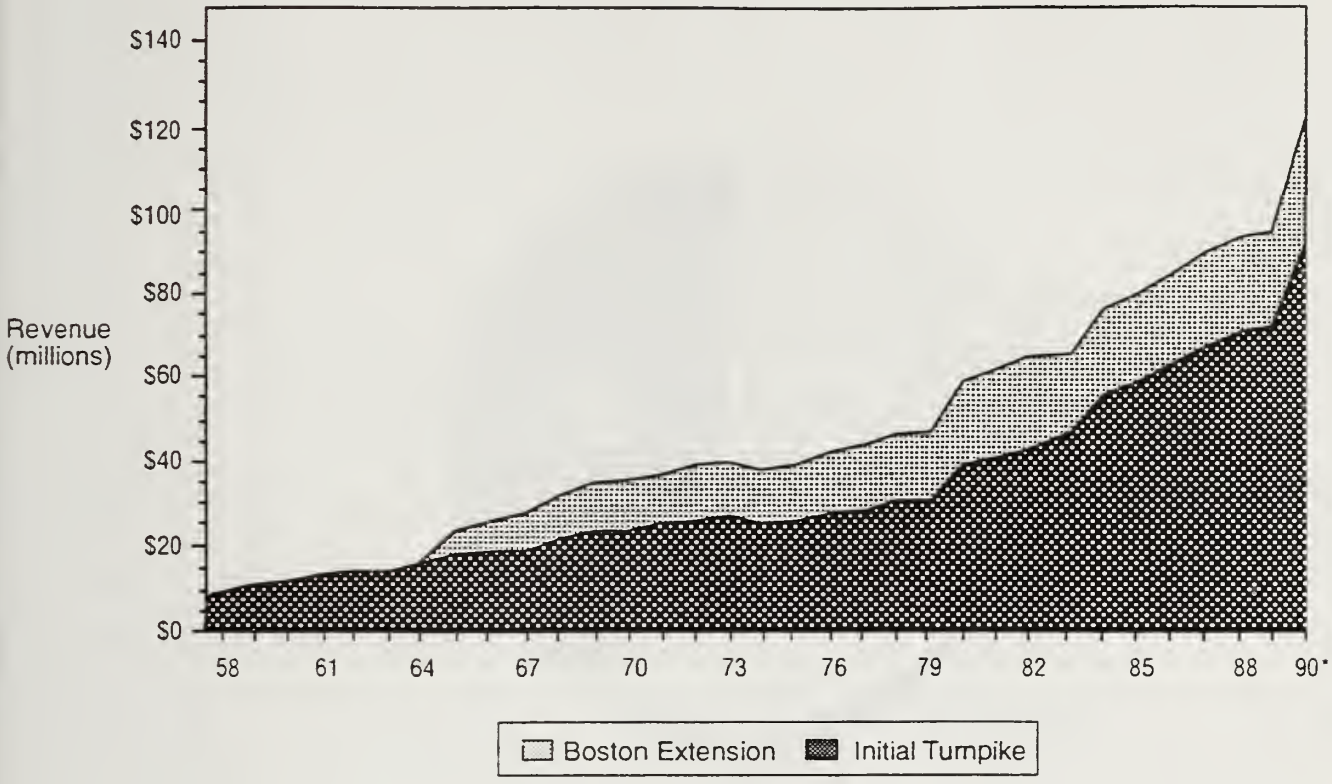
The Authority Board consists of three members appointed by the Governor for staggered terms of eight years. The members are required to take an oath before the Governor and to post bonds in the amount of $25,000 each for the faithful performance of their duties. The Authority can act only upon the concurrence of at least two of its members. Each member must be a resident of the Commonwealth and no more than two members may be of the same political party. The Chairman of the Authority is appointed by the Governor and the Vice Chairman is elected by the Authority. The Chairman serves as Chief Executive Officer of the Authority.

The Authority has approximately 1,400 full-time equivalent employees which include the turnpike's Troop E state police. Exhibit 2-13 shows the organization and staffing of the

Massachusetts Turnpike Authority

EXHIBIT 2-11

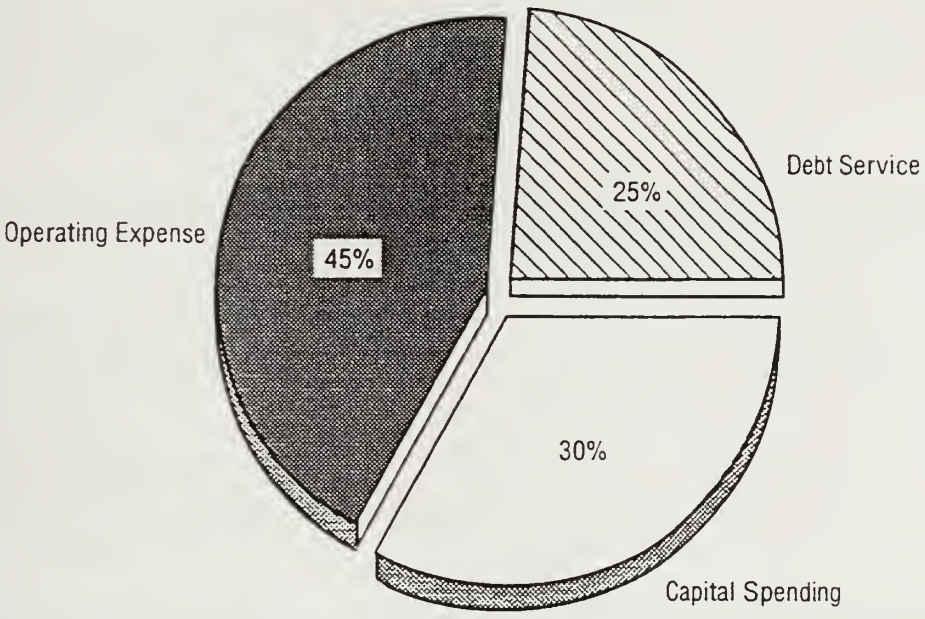
TURNPIKE REVENUE



* 30% toll increase implemented in 1990

Massachusetts Turnpike Authority Expenses for 1991

EXHIBIT 2-12



Dollar figures expressed in millions.

Expense Category*	Turnpike	Tunnel	Total
Operating Expense	$ 57.6	$ 11.2	$ 68.8
Capital Spending**	45.0	.0	45.0
Debt Service	32.1	5.8	37.9
	$134.7	$17.0	$151.7

** See page 2.23 for definitions of expense categories.*
*** Capital spending on rehabilitation program.*

Authority's line and staff functions. The Authority is organized into five departments. The departments, their functions, and number of full-time equivalent staff follows:

- **Operations.** 80 percent of the Authority staff is in this department with 1,237 full-time equivalent staff performing the following key functions:

  Toll collection
  Maintenance
  Tunnels
  Engineering/construction
  Patron services
  Occupational safety
  State Police Law Enforcement and Patrols

- **Secretary/Treasurer.** This is the second largest department in the Authority with 97 full-time equivalent staff performing the following key functions:

  Accounting and payroll
  Toll audit and external auditing
  Insurance
  Investments
  Support services
  Information technology and systems
  Retirement

  In addition, the First Deputy Secretary/Treasurer is a senior executive staff member who generally reports to the Secretary/Treasurer, but who also directly reports to the Chairman on matters of capital finance. The First Deputy Secretary/Treasurer has responsibility for the following functions:

  Capital finance
  Purchasing
  Budget

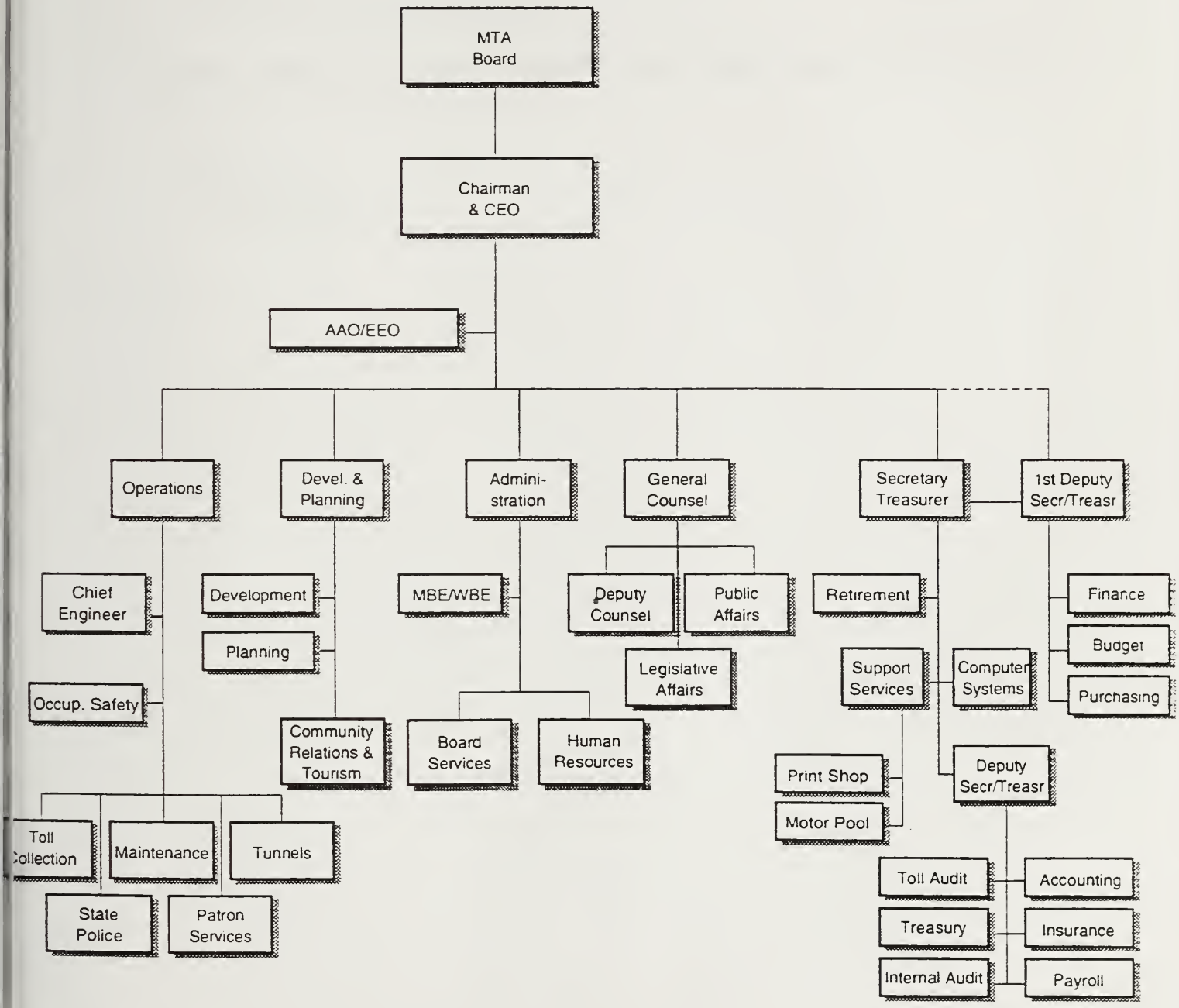
- **Administration.** There are 25 full-time equivalent staff currently with this department performing the following functions:

  Human resources
  Board services (liaison and administrative support to the Board)
  Minority business and woman business enterprise programs

Massachusetts Turnpike Authority

EXHIBIT 2-13

CURRENT ORGANIZATION AND STAFFING CHART



- **Development and planning.** This department was formed in 1990 and manages the community relations program, administers commercial leases, coordinates facility development, and seeks to capitalize on commercial opportunities from land and air rights development. It has 21 full-time equivalent staff and is organized into three units:

  Development
  Planning
  Community relations and tourism

- **General Counsel.** This department operates with 12 full-time equivalent staff and is organized into three units:

  Legal
  Public affairs
  Legislative relations

MASSACHUSETTS TURNPIKE AUTHORITY
ANALYSIS OF THE FUTURE ROLE AND STRUCTURE OF THE AUTHORITY

CONTENTS

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	Background and evolution of the Massachusetts Turnpike Authority	1.2
	Study purpose and objectives	1.3
	Methodology	1.4
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	Authorized powers and responsibilities	2.1
	Physical characteristics and condition of pavement and bridges	2.3
	Operating characteristics and services	2.13
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	Organization and staffing	2.23
3	**Comparison of the Authority with other turnpikes**	3.1
	Survey sample	3.1
	Survey results	3.2
4	**Assessment of Authority organization and management practices**	4.1
	Legally authorized powers and responsibilities	4.1
	Mission, goals, and policies	4.3
	Operational structure	4.7
	Capital improvement program	4.23
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	Conclusion	4.34

3. COMPARISON OF THE AUTHORITY WITH OTHER TURNPIKES

This section presents comparable information regarding the operating, staffing, safety, and capital program planning characteristics of a sample of major northeastern turnpikes. This information provides a useful basis for assessing the relative operating and resource characteristics of the Massachusetts Turnpike Authority and its Turnpike and Tunnel facilities.

SURVEY SAMPLE

In order to benchmark how the Authority's organization, staffing, and operations compare to other turnpikes, we selected five turnpikes to survey:

- Garden State Parkway (GSP)
- New Jersey Turnpike (NJT)
- New York State Thruway (NY)
- Ohio Turnpike (OH)
- Pennsylvania Turnpike (PA)

These turnpikes were selected based upon:

- Geographic location/comparable weather
- Age of facilities
- Level of toll transactions
- Agency focus on turnpike (as opposed to other modal) responsibilities

The purpose of the survey was to compare and analyze how the Authority is structured and staffed versus other turnpikes. Consequently, the information was gathered with the intent of providing a framework for our analysis rather than detailed conclusions. The analysis is structured to provide consistent comparisons; however it must be noted that each toll facility has "unique" characteristics that are noted below.

SURVEY RESULTS

The results of the survey of comparable northeastern turnpikes are presented in terms of the general operating, staffing, cost, and capital plan characteristics of each turnpike relative to each other and MassPike.

General Characteristics

The general characteristics of the peer group are summarized in Exhibit 3-1. The summary indicates:

- **Toll transactions.** The Garden State Parkway (GSP) handles almost 15 times the number of toll transactions than the Ohio Turnpike, yet each has roughly the equivalent number of lane miles. This is due, in part to the heavily populated area it serves and in part because GSP uses 11 across-the-road barriers to collect its tolls. The average driver pays multiple tolls when traveling on the GSP. In fact, in 1989, the GSP sold over 150 million tokens for use in its "Token Only" plaza lanes (almost one-third of its total volume).

  In contrast, Ohio charges tolls based solely on the distance traveled (and gross-weight for trucks). A driver receives a ticket and only pays once upon leaving. This configuration is typically called a closed interchange system. Still others, like Massachusetts and New York have a combination system of barriers and closed interchange systems.

  All things being equal, transactions divided by lane mile provides a measure of turnpike utilization. The following list, ranked from high to low, shows the number of transactions per lane mile (in thousands) of our peer group:

1.	Garden State Parkway	489
2.	Massachusetts Turnpike	218
3.	New Jersey Turnpike	206
4.	New York State Thruway	120
5.	Pennsylvania Turnpike	54
6.	Ohio Turnpike	33

- **Average trip length.** The Massachusetts Turnpike, like the GSP and New Jersey Turnpike, has much shorter average trip lengths than the toll facilities in New York, Ohio, and Pennsylvania. This suggests that the Massachusetts Turnpike serves shorter commuter trips than the much longer facilities in New York, Ohio, and Pennsylvania which serve longer interstate and intrastate travel.

- **Center-line and lane miles.** Center-line miles correspond to the overall length of a turnpike. Turnpikes with a large number of "lane miles" per "center-line miles"

General Characteristics of Turnpikes and Tunnels

EXHIBIT 3-1

Characteristics	MassPike	GSP	NJT	NY	OH	PA
Toll Transactions (millions)	148	501	197	290	34	102
Average Trip Length (miles)						
Passenger Vehicles	27	15	23	42	56	38
Commercial Vehicles	35	N/A	27	65	93	69
Center-line Miles	136	173	144	559	241	470
Lane Miles*	676	1,024	956	2,410	1,037	1,880
Tunnels	2	0	0	0	0	4
Bridges	260	488	480	812	537	1,019
Average Toll/Mile						
Passenger Vehicle**	$0.04	$0.02	$0.04	$0.03	$0.02	$0.04
5-Axle Vehicle	$0.14	N/A	$0.15	$0.12	$0.08	$0.12

* Main-line lanes included; excludes ramps, service areas, etc.

** Based on IBTTA Survey of 1991 Passenger Car Toll Rates.

typically serve higher traffic corridors like those in New Jersey and Massachusetts. Lower ratios such as in Pennsylvania, New York, and Ohio indicate these turnpikes travel through more rural areas where two-lane roadways in each direction are sufficient to carry the traffic.

- **Tunnels and bridges.** Massachusetts and Pennsylvania are the only turnpikes surveyed that have tunnels. Pennsylvania tunnels are through mountains and toll collection does not occur at the tunnels.

  Massachusetts, in contrast, has its tunnels in its largest urban area downtown Boston. The Sumner and Callahan Tunnels have separate toll collection plaza and the tunnel goes under the Boston Harbor. The Prudential Center pathway also provides travel under a city complex that is part of downtown Boston. The Callahan/Sumner Tunnels and the Prudential Center Passageway require significant maintenance, as noted below.

- **Average toll/mile**. The average toll/mile reflects the most recent 1991 toll rates. It is a measure of how much a turnpike charges "per mile traveled" by a passenger car or truck. Delaware (8.9¢/mile), West Virginia (4.3¢/mile), New Hampshire's Blue Star (4.2¢/mile) are eastern turnpikes with passenger toll rates higher than any of our survey peer groups. Within our peer group, the more urban turnpikes--Pennsylvania, New Jersey, and Massachusetts--have equivalent toll structures of four cents per mile for passenger cars. The other turnpikes, which serve more sparsely populated areas, have lower passenger rates. All turnpikes charge trucks about four times the rate they charge cars. This is to compensate for the extensive wear trucks cause to pavements and bridges. The toll rate of Massachusetts is consistent with and comparable to most of the other turnpikes. Only the Ohio Turnpike and the Garden State Parkway had lower toll rates.

Staffing Characteristics

The peer group staffing comparison is summarized on Exhibit 3-2. All numbers are shown in full-time equivalents (FTEs). It should be noted that several of the turnpikes have contracts for State Police coverage but few have the State Police incorporated into the overall organizational structure. In order to have comparable results, the size of the law enforcement staff operating on the respective turnpikes were added to each organization as shown in the exhibit. A more useful and relevant comparison is shown in Exhibit 3-3 which compares the relative percentage of staff with general categories among the peer group.

The percentage of staff distribution by function/department among the peer groups is very similar. Massachusetts is typical of the other turnpikes:

- Massachusetts falls in the middle of the group's range in the percentage of general and administrative staff to total staff.

Staffing Comparison (FTEs)

EXHIBIT 3-2

Department	MassPike	GSP	NJT	NY	OH	PA
General & Administrative						
Admin/Sec/Treas	116	173	156	300	72	171
Other (e.g., Board, Legal)	42	40	44	66	19	63
Subtotal	158	213	200	366	91	234
Operations						
Toll Collection	638	637	1,106	1,089	535	940
Engineering	57	49	51	134	17	151
Maintenance	389	460	580	1,263	369	754
Law Enforcement/Safety*	116	230	220	314	103	225
Other	37	32	42	78	17	0
Subtotal	1,237	1,408	1,999	2,878	1,041	2,070
Total	1,395	1,621	2,199	3,244	1,132	2,304

* Incudes the FTEs for "contracted" State Police patrols.

Staffing Distribution

EXHIBIT 3-3

Department	MassPike	GSP	NJT	NY	OH	PA
General & Administrative						
Admin/Sec/Treas	8%	11%	7%	9%	6%	7%
Other (e.g., Board, Legal)	3%	2%	2%	2%	2%	3%
Subtotal	11%	13%	9%	11%	8%	10%
Operations						
Toll Collection	46%	39%	50%	34%	47%	41%
Engineering	4%	3%	2%	4%	2%	7%
Maintenance	28%	28%	26%	39%	33%	33%
Law Enforcement/Safety*	8%	14%	10%	10%	9%	10%
Other	3%	2%	2%	2%	2%	0%
Subtotal	89%	87%	91%	89%	92%	90%
Total	100%	100%	100%	100%	100%	100%

* Incudes the FTEs for "contracted" State Police patrols.

- Operations as a percentage of the total organization ranges narrowly between 87-92 percent across the turnpikes surveyed. Massachusetts's 89 percent is in the mid-range of the group. The distribution of the personnel within the functions of operations were also very similar. Toll Collection and Maintenance are the largest functions in all authorities. Together these two functions encompass 67 to 80 percent of the total personnel in the turnpikes surveyed. This cumulative percentage of Toll Collection and Maintenance staff to total staff for Massachusetts is 74 percent and is typical of the other turnpike organizations.

Work Load and Cost Indicators

Selected work load and cost comparisons were developed from the staffing general characteristics and financial information and are shown in Exhibit 3-4:

- **Transactions/total FTE** - This is an overall organizational work load measure, relating production or output (i.e., transaction) to the resource applied to production. In this measure, we use full-time equivalent staffing level for the entire organization.

- **Transactions/toll collector** - This is a work load measure of the toll collection process. It measures the average number of transactions associated with each full-time equivalent staff member involved in toll collection activities.

- **FTE/lane mile** - This is another work load measure aimed at assessing the relative size of the organization to the physical size of the turnpike.

- **Maintenance FTE/lane mile** - This is an work load measure targeted at maintenance operations. It indicates the level of maintenance resources necessary to maintain one lane-mile of the turnpike.

- **Department disbursements/department FTE** - In Exhibit 3-4, there are three cost measures, relating total department expense disbursements to an equivalent full-time employee. In other words, its the average amount spent by one person performing that department's function. This measure was computed for the following functions:

  General and administrative (G&A)

  Toll collection

  Maintenance

- **Maintenance disbursements/lane mile** - A cost measure relating the average amounts spent on each turnpike lane mile for maintenance.

Work Load and Cost Indicators

EXHIBIT 3-4

Work Load Indicator	MassPike	GSP	NJT	NY	OH	PA
Transactions/Total FTE	105,695	309,132	89,651	89,396	30,090	44,271
Transactions/Collectors FTE	231,768	786,911	178,229	266,299	63,674	108,511
Total FTE/Lane Mile	2.07	1.58	2.30	1.09	1.09	1.23
Maintenance FTE/Lane Mile	0.57*	0.45	0.61	0.36	0.36	0.40

*Without tunnel maintenance FTEs, this ratio calculates to 0.5.

Cost Indicator	MassPike	GSP	NJT	NY	OH	PA
G&A Disbursements/ G&A FTE	77,095	104,944	159,462	39,260	153,892	57,282
Toll Collector Disbursements/ Toll Collector FTE	38,267	43,870	43,801	34,252	28,016	41,951
Maintenance Disbursements/ Maintenance FTE	55,188	66,188	57,118	40,797	51,943	47,199
Maintenance Disbursements/ Lane Miles	31,718	29,733	32,352	21,381	18,483	18,930

Exhibit 3-4 presents a comparison of these indicators. Key points revealed by the comparison are:

- Massachusetts spends less to perform general administrative functions and toll collection functions than half of its peer group.

- Massachusetts is second to the Garden State Parkway in terms of "transactions per total FTE." The Authority serves a high volume of users relative to its overall staffing level. This is a very favorable overall efficiency indicator.

- Massachusetts is among the top three of the peer group in terms of "transactions processed per toll collector." This indicates Massachusetts Toll Collection units have a high work load relative to the other authorities. It also demonstrates the effective and efficient use of automated toll equipment and toll collectors.

- Massachusetts had the second highest number of "Total FTE/Lane Mile" and "Maintenance FTE/Lane Mile." Massachusetts, like the New Jersey Turnpike, serves high-traffic volume urban areas that may contribute to this ranking.

  In addition to having to operate and maintain one of the more heavily traveled turnpikes, Massachusetts also operates the Sumner and Callahan Tunnels. There are 154 FTEs required to operate and maintains the tunnels which are only one mile long (for a total of four-lane miles). The high concentration of personnel at the tunnels affects the work load ratios. Accounting for this "tunnel effect," the Maintenance FTE/Lane Mile work load indicator would decrease from .57 to .50. None of the other turnpikes we surveyed have distinct tunnel operations (i.e., noncontiguous to the expressway and separate from the expressway toll collection system). The tunnels are submerged, which contributes to their extensive maintenance requirements.

- Although not the highest, maintenance cost indicators appear relatively high. As this survey represents a "snapshot" in time, the higher figure may reflect the Authority's increased level of maintenance activity due to its current rebuilding program or conversely, it may present an opportunity to examine the Authority's current maintenance practices against those of its peers to determine if operational changes are required.

Safety

The Authority's safety record is shown in Exhibit 3-5. Massachusetts was the safest of all the turnpikes surveyed by each of the following indicators:

- Fatality rate

- Property damage accident rate

1990 Safety Indicators

(Per 100 million Vehicle Miles Traveled)

EXHIBIT 3-5

Safety Indicator	MassPike	GSP	NJT	NY	OH	PA
Accident Rate						
Property Damage	59	59	95	72	66	84
Personal Injury	13	33	33	22	18	18
Total	72	92	128	94	84	102
Fatality Rate	0.50	0.50	0.61	0.91	0.60	0.60

- Personal injury accident rate

Safety of the millions of motorists who depend on the Turnpike and Tunnels is the Authority's number one priority. MassPike appears very effective in achieving an outstanding safety record.

Capital Plan Comparisons

The following is a brief narrative description of the capital plans of the turnpikes surveyed.

Garden State Parkway (GSP)

Prior to 1988, the GSP planning process leading to adoption of successive capital programs reoccurred periodically on an as-needed basis. Currently, GSP reviews and revises its capital program on an annual basis. A multiyear capital program proposed to be undertaken during the next five years is recommended to the Board of Commissioners, together with an annual capital program element. Each year the process is repeated to determine the next Annual Capital Element.

GSP adopted a $280,460,000 five-year rolling capital improvement program for the period 1990-94. As Exhibit 3-6 shows, of the resources associated with this program, 59.3 percent are allocated toward System Preservation. The $166,375,000 allocated toward System Preservation is intended to prevent further deterioration of the Parkway's highway and bridge system. Of the program's resources, 36.3 percent are allocated to Capacity Enhancement. Funding for this category totals $101,829,000, and is intended to expand and enhance GSP's transportation facilities. Of the program's resources, 3.8 percent are allocated to Toll Facilities. Funds associated with this category total $10,706,000 and are directly related to the proposed new Atlantic County toll barrier at approximately Milepost 44. The last category, Patron Services, is comprised of 0.6 percent of the program's resources or funding in the amount of $1,550,000. Patron Services projects are intended to expand and enhance GSP's public service assets and resources.

New Jersey Turnpike (NJT)

Since 1984, NJT has been actively developing plans for expanding the toll road's capacity in northern and central New Jersey. It was originally anticipated that the projects, collectively described as the "Widening Program" would be completed by 1990. The program was to be paid for by a $2 billion bond issue sold in 1985.

The Widening Program as originally conceived included the following major elements:

- Widening from six lanes to 10 lanes from Interchange 8A near Jamesburg to Interchange 9 at East Brunswick

EXHIBIT 3-6

GARDEN STATE PARKWAY CAPITAL PLAN

Description	Total Cost	Percent
System Preservation	$166,375,000	59.3%
Capacity Enhancement	101,829,000	36.3%
Toll Facilities	10,706,000	3.8%
Patron Services	1,550,000	0.6%
TOTALS	**$280,460,000**	**100.0%**

- Widening from 12 lanes to 14 lanes between Interchange 11 near Woodbridge to the merge point of the eastern and western alignments of the Turnpike near Newark
- Widening from six lanes to 12 lanes at the western alignment from Interchange 14 to Interchange 18W
- Widening from four lanes to eight lanes from Interchange 18W to Route 46.

The Authority failed to adequately anticipate the magnitude of the environmental permitting obstacles involved in the widening of the western alignment between Interchange 14 and Interchange 18W, proceeding instead with the design process, at a cost of about $69 million.

Because of the permitting delays and the rapidly escalating total costs of the Widening Program, a decision was made in mid-1989 to pursue a revised, less costly program.

New York State Thruway (NY)

The original sections of the New York State Thruway are over 36 years old. Despite traffic growth, vehicle weight loadings, and harsh winters and hot summers, the road has served well beyond the normal life expectancy of the original concrete pavements and is close to the design life expectancy of the bridge structures. Therefore, major roadway and bridge rehabilitation work is necessary to maintain its 2,800 lane miles of roadway and 855 bridges. (The addition of the Cross-Westchester Expressway and I-84 boosts these numbers to 3,240 lane miles and 1,026 bridges.) The New York State will be rehabilitating the Cross-Westchester Expressway and I-84 as a condition of transferring jurisdiction to the Thruway Authority.

To meet this need of major rehabilitation, and to continue to provide a safe facility for Thruway patrons, a major systemwide bridge and roadway rehabilitation program was begun in 1988. Almost every lane mile of mainline will have been resurfaced or rehabilitated between 1985 and 1996. The program was estimated to cost $1.7 billion through 1996. While less than halfway through this program, it is likely that the final cost will exceed this amount due to enhancements required to meet current design standards for reconstruction. The program was predicated upon receiving $269 million in federal funds during the period 1988 to 1996. This amount is subject to change based on federal budget restrictions.

Ohio Turnpike (OH)

The 1992 projected capital improvement program is $35 million. The Turnpike is in its eighth consecutive year of its bridge deck replacement and widening program. In 1990, the program consisted of:

- Total bridge deck replacement and widening of 14 mainline bridges
- Deck replacements of 16 cross-road and ramp bridges
- Latex-concrete overlays of seven bridges

There are six mainline bridges and 94 cross-road and ramp bridges remaining to be rehabilitated under the program that began in 1987.

Pennsylvania Turnpike (PA)

In 1985, the General Assembly of the Commonwealth of Pennsylvania enacted legislation which, among other things empowered the Pennsylvania Turnpike Commission to undertake the construction of new projects and to operate them as part of the Pennsylvania Turnpike System. The initial group of projects includes the following, all or a portion of which are being or have been financed with $300 million of 1986 bond proceeds:

- **Six-lane widening.** Traffic volume in the Philadelphia area has demonstrated the need for the six-lane facility from the proposed Mid-County Interchange east to the westbound entrance and eastbound exit ramps of the Philadelphia Exchange.
- **Mid-County Expressway connection.** This project provides a direct connection between the Mid-County Expressway (Interstate Route 476) and the Pennsylvania Turnpike System. An interchange between these two major highways will provide the suburban Philadelphia area with additional regional roadway capacity and relieve some of the traffic growth problems in the Conshohocken-King of Prussia-Valley Forge area.
- **Beaver Valley Expressway.** This project will complete the 15.6-mile missing part of the Beaver Valley Expressway, which is located between the Greater Pittsburgh

International Airport in Allegheny County and I-80 near Sharon, Pennsylvania, in Mercer County. The project, which will be constructed as a four-lane toll road, is located in Beaver and Lawrence counties in western Pennsylvania and generally parallels Pennsylvania Route 18, one to two miles to the west.

- **Greensburg (North-South) bypass.** This project will provide a 13-mile connection between a major interchange at the northern terminus of U.S. Route 119 and the New Stanton Interchange (Exit 8) of the Turnpike and an existing interchange between U.S. Route 22 and Pennsylvania Route 66 near Delmont. The project is located in Westmoreland county in western Pennsylvania.

- **Fort Washington, Willow Grove, and Philadelphia Interchanges.** The Fort Washington, Willow Grove, and Philadelphia Interchanges were reconstructed to increase traffic capacity through the toll plazas and the trumpet type interchanges. Work included increasing the number of toll lanes through the plazas, constructing additional toll booths and new utility buildings, reconstructing ramp and plaza pavement, bridge widening and redecking, drainage modifications, and new high mast lighting. Also included was the widening of the Turnpike Mainline from four to six lanes through the interchanges, new interchange ramps and bridges, and the replacement of the median guide rail with a concrete median barrier.

- **Beaver Valley Climbing Lane.** The eastbound traffic lanes east of the Beaver River Bridge will be widened from two lanes to three lanes over the ascending grade from Milepost 13.4 to Milepost 15.7. This additional lane will accommodate slower moving vehicles while maintaining two traffic lanes for normal traffic. In addition, the project includes the resurfacing of the existing two eastbound lanes and two westbound lanes, the placing of a concrete median barrier in the reconstructed median, and alterations to the existing bridge carrying Traffic Route 65 over the Turnpike.

- **Additional Lehigh Tunnel.** This project has been developed in order to enhance the flow of traffic in the vicinity of the existing two-lane, two-way Lehigh Tunnel in Lehigh and Carbon counties on the Northeast Extension of the Turnpike. The project proposes that a second two-lane tunnel be constructed for southbound traffic parallel to and west of the existing tunnel.

  The length of the new tunnel, portal to portal, will be 4,378 feet. A minimum vertical clearance of 16' 6" will be provided in the new tunnel. The tunnel lining, drainage, lighting, and ventilation systems will be similar in both tunnels. The mechanical and electrical systems in the existing tunnel will be upgraded and improved once the new tunnel is in operation. Beyond the tunnel portals, the roadways approaching the tunnel will be adjusted to provide for the new southbound lanes. The total length of the project will be 10,956 feet, or 2.08 miles.

MASSACHUSETTS TURNPIKE AUTHORITY
ANALYSIS OF THE FUTURE ROLE AND STRUCTURE OF THE AUTHORITY

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4. ASSESSMENT OF AUTHORITY ORGANIZATION AND MANAGEMENT PRACTICES

This section presents a series of assessments regarding the Authority's:

- Legally authorized powers and responsibilities
- Mission, goals, and policies
- Operational structure
- Capital improvement programming practice
- Financial structure
- Information systems

The findings of these assessments are summarized next.

LEGALLY AUTHORIZED POWERS AND RESPONSIBILITIES

In general, the Authority has been granted sufficient powers and authority under Chapter 354 of the Turnpike Act and Chapter 598 of the Tunnel Act to allow the Authority to accomplish the objectives for which it was initially created. Based on a preliminary survey of various available official statements relating to bonds issued by comparable authorities (e.g., transportation commissions, toll bridge authorities) in states other than Massachusetts, the Authority's authorized powers and responsibilities do not vary significantly from those of such other authorities, either in terms of general corporate powers or in terms of specific authorizations pertaining to the construction, maintenance, repair and operation of turnpikes (or other highway and bridge systems). However, if it is desirable for the Authority to expand its responsibilities significantly, additional legislation might be required to expand the Authority's corresponding powers and authority to meet the new responsibilities.

The following review summarizes the more significant issues regarding the Authority's powers and responsibilities. Unless otherwise noted, reference is to both the Turnpike and Tunnel acts.

Bonding - Refunding. The Authority's authority to issue revenue bonds under the Tunnel Act is limited by the requirement that the bonds be issued, and the proceeds thereof used, for the purpose of paying costs of the Tunnels, such costs being defined in the Act, while the Turnpike Act permits the issuance of bonds for any corporate purpose as provided in the

Act. The Authority is authorized to issue revenue refunding bonds for the purpose of refunding any of its outstanding bonds issued in accordance with the provisions of the Turnpike and Tunnel acts and, if it determines it advisable, for the additional purpose of constructing additional portions of the Turnpike, or for improvements, extensions, or enlargements of the Turnpike or the tunnels.

One problem arising from the current wording of the Authority's bonding authority is that although other means of financing may be available to the Authority there is no explicit authorization for the Authority to issue Tunnel bonds for the purpose of repairing the tunnels.

The Authority's authority regarding utilization of air rights over land owned or held by the Authority allows the Authority to make facilities available for or derive income from nonturnpike activities. The Turnpike Act authorizes the Authority to lease such air rights for nonturnpike purposes if, in its discretion, the Authority determines that these purposes will not impair the construction, use, safety, maintenance repair, operation or revenues of the Turnpike (and subject to certain other conditions). The Turnpike Act further requires any revenues derived from such leases to be applied either toward the cost of the Turnpike's operation or deposited to the sinking fund for the appropriate bonds issued under the Act. Analogous statutory language with regard to use of and leasing of Authority equipment would be useful.

Massachusetts Tort Claims Act. The Authority is currently liable to any person for personal injury and property damage sustained as a result of a defect or want of repair therein or thereon to the same extent as if the Turnpike (or the tunnels) were a "way" within the meaning of sections 14, 15, 18, and 19 of Chapter 84 of the General Laws, and is liable for the death of any person caused as a result of such defect or want of repair to the same extent as is provided in Chapter 229 of the General Laws.

The Massachusetts Torts Claim Act, G.L. Ch. 258, expressly excludes the Authority from the definition of "Public Employer," for the purposes of the Act. Accordingly, the Authority is not entitled to any governmental or sovereign immunity with respect to any of its liabilities described above. As a result of this exclusion, the Authority cannot benefit from the limitations on liability in the Torts Claims Act, which provides that a public employer is not liable (1) to levy of execution on any real or personal property to satisfy judgments, (2) for interest prior to judgment or for punitive damages, and (3) for any amount in excess of $100,000.

In *Karlin v. Massachusetts Turnpike Authority*, 399 Mass 765, 506 N.E.2d 1149 (Mass 1987), the Supreme Judicial Court reiterated the public policy reasons for the Authority's exclusion. The SJC ruled that "as an independent authority, supported by its own nontax revenue sources and without the Commonwealth's credit pledged on its behalf, the Authority's circumstances do not present the need for the protection of public funds which underlay the reason for governmental immunity."

MISSION, GOALS, AND POLICIES

The effective and efficient management and operation of an organization is based, in part, on the existence and application of clear, well documented, and up-to-date mission statement, goals and objectives, and guiding policies and principles. This subsection assesses the Authority's mission statement, goals, and objectives, and the examines its guiding policies and principles in the following terms:

- Do they exist?
- Do any gaps or weaknesses exist?
- Are they being communicated and used?

Our assessment of the Authority's mission statement and goals is based on the following strategic planning hierarchy and definitions:

- **Mission statement.** A statement of an organization's main purpose specifying its business and who are its customers or constituents.
- **Goal.** General statements about the direction in which an agency intends to go, without stating specific targets to be reached at particular points.
- **Objective.** A specific statement that is an outgrowth of a goal, stated so that it is possible to measure the extent to which the goal has been attained at a specific point.
- **Performance measures.** Indicators used to assess the level of attainment of an objective

Using the above hierarchy, the findings of our analysis are presented below.

Mission and Goals

In 1991, the Authority developed an updated mission statement and goals. The Authority's updated mission statement is presented below:

> MassPike's primary mission is the operation and maintenance of a safe and efficient highway and tunnel system. Through the end of the decade, the Authority's mission is the continued first class maintenance of the harbor tunnels and the most important east-west transportation corridor in the state through an enlarged and expedited rehabilitation program; the timely investment in projects that enhance efficiency and road and tunnel safety, respect the environment, promote tourism, and create employment

> and development opportunities; and the vigilant management of a cost effective transportation agency.[1]

The Authority's primary mission as noted in the first sentence of its overall mission statement is "the operation and maintenance of a safe and efficient highway and tunnel system." However, this statement should include a reference to financial self-sufficiency of the MassPike system as a tolled facility, and should identify the Authority's "customers or constituents." We recommend revising the mission statement to read as follows:

> *MassPike's mission is the operation and maintenance of a safe, efficient, and financially self-sufficient tolled highway and tunnel system which serves the surface transportation needs of Massachusetts in an environmentally sensitive manner.*

Goals

The Authority's overall goals and key initiatives are presented in Exhibit 4-1. The adopted MassPike performance goals for 1991 are presented in Exhibit 4-2.

The Authority needs to articulate more clearly its goals and distinguish them from action-oriented initiatives. For example, the second sentence of the Authority's mission statement appears to state the direction the Authority intends to go, which corresponds to goal statements according to the above hierarchy. For example, the Authority's goals can be interpreted to be:

- Implement an enlarged and expedited rehabilitation program
- Make timely investment in projects that enhance travel efficiency, economic productivity, and road and tunnel safety
- Respect (i.e., clean up and protect) the environment
- Promote tourism and create employment and development opportunities
- Vigilantly manage a cost-effective transportation agency

The above set of "goals" is similar to but more comprehensive than the Authority's goals and key initiatives already listed. Exhibit 4-1 appears to be a list of key Authority initiatives rather than its goals.

---

[1] March 14, 1991, memorandum of A.R. McKinnon to Secretary of Transportation, R. Taylor.

EXHIBIT 4-1

MASSPIKE GOALS AND KEY INITIATIVES

- Rebuilding the Authority's infrastructure
- Establishing the Authority as a regional model in traffic management
- Capitalizing on the Authority's unique strengths to be a catalyst for economic growth by:

  Promoting tourism
  Encouraging air rights development

- Building a well-trained and diverse work force

Source: March 14, 1991, memorandum of A.R. McKinnon to Secretary of Transportation, R. Taylor.

EXHIBIT 4-2

1991 MASSPIKE GOALS

- To sustain MassPike's record Capital Improvement Program, as generally outlined in the report, *Critical Needs for the 1990s*, and to move forward with and complete the tunnels rehabilitation program as recommended by the Consulting Engineers.

- To establish a strong financial management system with effective cost containment mechanisms, and a close monitoring of MassPike revenues, in order to meet the goal of a balanced budget at year's end and to position the Authority financially to prepare a responsible 1992 budget.

- To initiate the necessary studies and assemble resource and planning tools to enable the Authority to establish a comprehensive real estate/development plan.

- To make improvements in the safe and efficient movement of traffic through a number of traffic management initiatives and technological improvements.

- To establish a strategy to enable MassPike, if asked, to participate in the maintenance and operation of the Central Artery/Tunnel facilities and to take the necessary preparatory steps to move ahead should that role be assigned to the Authority.

- To establish human resource support programs that will improve productivity and enhance the effectiveness of MassPike operations in the areas of hiring, affirmative action, cultural diversity, training, labor relations, incentive programs, and communication of personnel policies, procedures, and benefits.

- To create and promulgate a new environmental protection policy, including a comprehensive traffic management program and a comprehensive set of design guidelines aimed at protecting the environmental quality and natural beauty of the Turnpike corridor and Tunnel entrances.

- To make a concerted effort to further improve MassPike's relationship with patrons, public officials, and private citizens along the Turnpike corridor and Tunnels.

- To maintain MassPike's high standard of public safety through a continued strong State Police presence and effective maintenance programs.

- To capitalize on the Authority's unique strength and financial independence to create revenue producing public works projects and public/private development.

Exhibit 4-3 presents a recommended set of goals for the authority. This listing builds upon but is somewhat broader than the goals listed in Exhibit 4-1.

Objectives

The 1991 MassPike goals in Exhibit 4-2 represent an initial very useful Authority effort to define annual performance objectives to focus and guide the use of Authority resources and to promote management and staff accountability. Exhibit 4-2 has been used by Authority senior staff to formulate their individual objectives for 1991. In the future, as its performance evaluation program becomes more fully implemented, the Authority should:

- Develop performance measures for each goal/objective to facilitate monitoring goal and objective attainment. This would complete the hierarchy of goals, objectives, and performance measures recommended above.

- Review, update as appropriate, and distribute throughout the Authority its mission statement, goals, and annual performance objectives to guide the management and operation of the Authority and to serve as input to the Authority's new performance evaluation program that was implemented in 1991.

Policies and guiding principles

The efficient and effective management and operation of the Authority, like other organizations, is predicated on the existence of current and sound policies and principles.

In addition to the Authority's mission statement, overall goals, and performance objectives, the Authority's operation is guided by the many policy and procedure manuals and regulations listed in Exhibit 4-4. A number of the policy and procedure manuals cited in Exhibit 4-4 have been developed or revised since 1987. These include the procurement procedures and the travel reimbursement policy. It should be noted that a detailed review of each of these manuals and regulations was not undertaken as part of this study.

Our review of available policy and procedure manuals indicates that the manuals/guidelines listed in Exhibit 4-5 do not exist and/or are acknowledged by the Authority to be out of date and need to be revised. The Authority follows established policies and procedures in most of these areas, but has not documented such policies and procedures in some cases. The Authority should develop or update, as required, these manuals.

OPERATIONAL STRUCTURE

This subsection provides an assessment of the organizational structure and the operational practices of the Authority. The recommendations that follow focus on opportunities to

EXHIBIT 4-3

RECOMMENDED MASSPIKE GOALS

- Rehabilitate and preserve the condition of its highway and tunnel system
- Enhance system safety, efficiency, comfort, and convenience
- Protect and clean up the environment
- Promote tourism and economic development
- Manage a cost-effective, financially self-sufficient Authority
- Build and retain a well trained, productive, and diverse work force

EXHIBIT 4-4

EXISTING POLICY AND PROCEDURES MANUALS USED BY THE AUTHORITY

- *Procedures for the Procurement of Goods, Supplies, and Equipment by Departments of the Massachusetts Turnpike Authority* (July 1991)
- *Snow and Ice Control Manual* (December 1991)
- *AASHTO Green Book and FHWA Design Standards*
- *Equipment Replacements Standards*
- *Construction Management - Inspection Manual*
- *State and Federal Environmental Policies and Regulations*
- *Travel Reimbursement Policy*
- *Code of Conduct*

EXHIBIT 4-5

POLICY AND PROCEDURES MANUALS RECOMMENDED FOR DEVELOPMENT BY THE AUTHORITY

- *Highway Maintenance Policies and Standards*
- *Bridge Maintenance Policies and Standards*
- *Tunnel Maintenance Policy and Standards*
- *Equipment Maintenance Polices and Standards*
- *Strategic Planning Process Manual*

improve the efficiency and effectiveness of an organizational structure that has evolved. Most of the recommendations can be implemented within a short time frame. Others are longer term, in that they are contingent on the successful implementation of short-term changes and/or completion of short-term planning projects.

The organizational and operational assessment is based on:

- Review and assessment of Authority analyses, reports, studies, manuals, procedures, policies, and related materials
- Diagnostic interviews with senior executive staff and other appropriate management personnel
- Comparative survey and analyses with five similar toll road organizations
- Operational evaluations conducted for other state transportation and toll road organizations

Recent evolution of the Authority's organizational structure

Prior to 1988, when much of the top management of the Authority changed as a result of retirement, MassPike had a fairly flat organizational structure. As shown by chart on the left side of Exhibit 4-6, there were 11 major line and staff units that reported to the chairman of the Authority Board. This resulted in a very broad span of control for the chairman and limited the opportunity for coordination and synergy among units that shared related functional responsibilities.

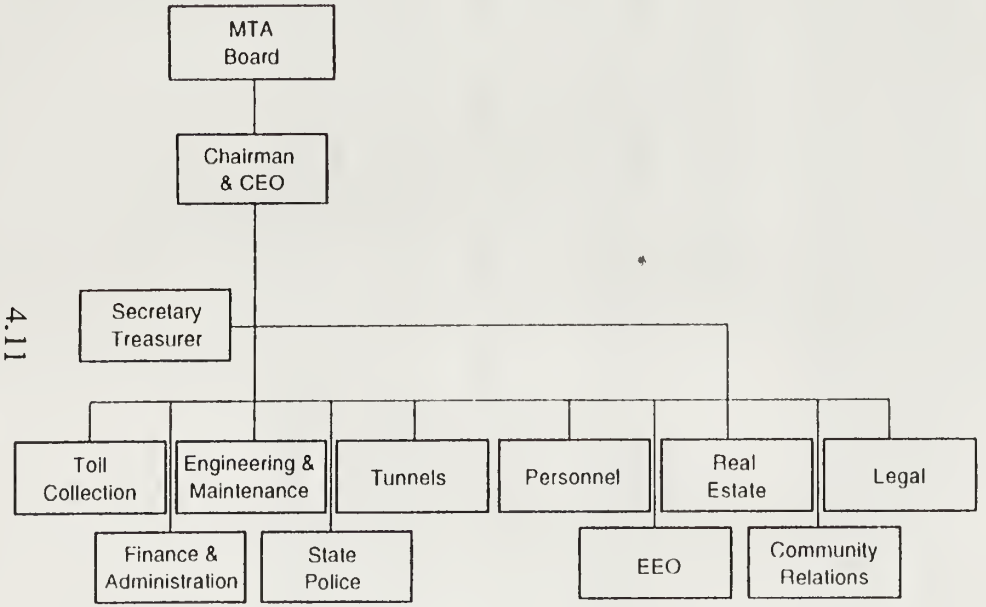
With the advent of the new management team in 1988, the Authority's organization structure was changed, as shown by the chart on the right side of Exhibit 4-6. The Authority's current organizational structure has five major departments. Among these departments, the Operations Department is by far the largest, representing about 1,230 staff or 89 percent of the Authority's personnel complement. The current structure provides a more manageable and reasonable span of control for the chairman of the Authority Board. It also provides much greater opportunities for coordination among units with related responsibilities, particularly in the operations and Secretary/Treasurer areas. The current organization structure also incorporates new/strengthened functions and units that the Authority has implemented to meet its objectives. These include: the new Development and Planning Department that is responsible for planning and developing the Authority's real estate and air rights assets as well as managing the Authority's tourist information and community relations programs; and the First Deputy-Secretary's unit that is responsible for capital financing, budgeting, and purchasing.

Massachusetts Turnpike and Tunnels

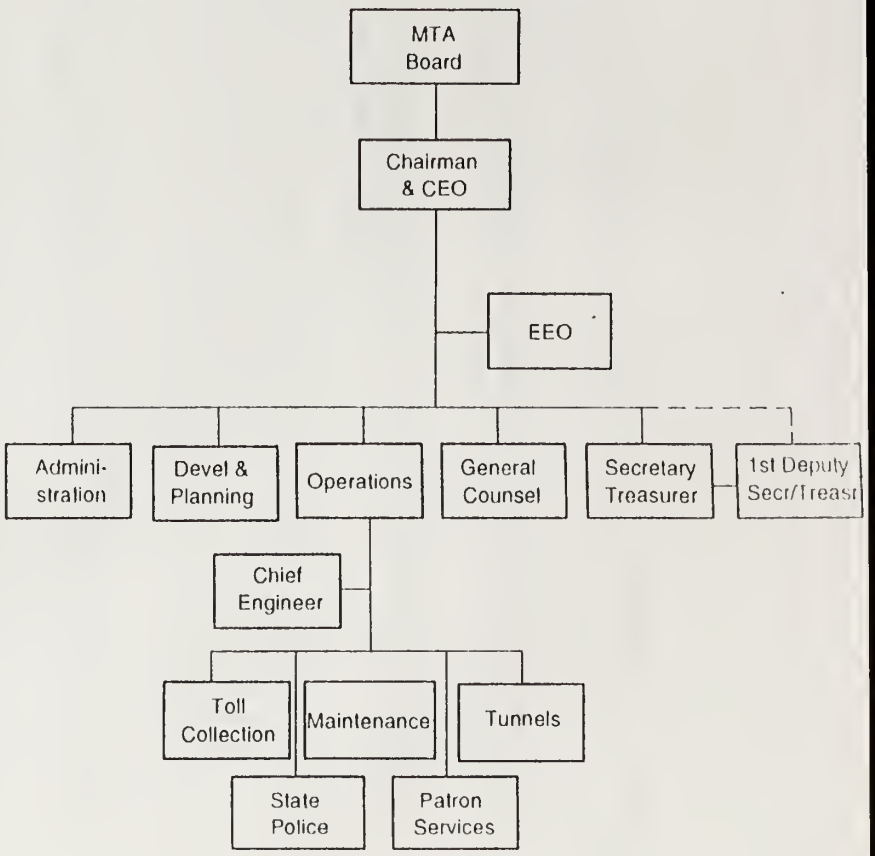
EXHIBIT 4-6

FORMER AND CURRENT ORGANIZATIONAL STRUCTURE

Former Organizational Structure



Current Organizational Structure



Based on our fact-finding, the Authority, under the Board's direction, displays the following attributes:

- It has a strong customer service orientation that focuses on anticipating and meeting the needs of Turnpike and Tunnel users and Commonwealth residents

- It has become a more decentralized and collaborative organization with more effective integration of Turnpike and Tunnel operations

- It has attracted a new senior staff team since 1987 that is gender and ethnically diverse and has the expertise to both continue the Authority's long history of commitment to effective operations of its facilities and to undertake new high-priority economic development, travel demand management, financing, and information systems initiatives

- It has undertaken a variety of new initiatives to increase revenues, control costs, and strengthen management controls, including:

  Adopting a code of conduct for governing employee behavior

  Retaining a new general consultant for the tunnels

  Advertising for consulting engineering and other professional services

  Negotiating a new agreement with Mobil Oil Corporation to operate gasoline service stations along the Turnpike that reduces gasoline prices and increases Authority revenues

  Revising insurance programs for managers

  Implementing remedial environmental programs at service areas and depots and adopting new policies, such as its salt application policy, to prevent negative impacts in the future

Proposed refinements to the Authority's organizational structure

The Authority has made significant progress during the last few years in establishing a more balanced and effective organizational structure. Based on the fact-finding and analysis efforts already outlined, a number of additional refinements are suggested to enhance the efficiency and effectiveness of the Authority. These recommended changes are described below.

Operations

The Operations Department consists of the Engineering, Construction, Maintenance, Toll Collection, State Police, Patron Services, and Tunnels divisions.

A. Tunnels Division

Finding. The Tunnels Division has historically operated as a separate organizational unit within the Authority. This is most likely attributable to the fact that it was acquired from the City of Boston as a separate entity and has mandatory requirements to administer its revenues and bond proceeds separately from the Turnpike.

Prior to 1987, the Tunnel Division was administered autonomously from Turnpike operations. The Tunnels Division now reports to the Director of Operations. Based on recent clarifications and changes in responsibilities, overall engineering work for the tunnels is now directed by the Chief Engineer. This is an improvement since 1987. The recent organizational changes have improved its accountability, as well as its planning, and engineering functions. The remaining Tunnels functions, toll collection and maintenance, still remain separate from their functional equivalents--the Turnpike Divisions of Toll Collection and Maintenance.

Recommendation. The Authority should functionally integrate the Tunnel's toll collection and maintenance functions into the Turnpike's toll collection and maintenance divisions. This consolidation will help unify training and planning, and maximize utilization of staff and equipment. It should also reduce the overall costs of operations through reductions in the current levels of management and the attainment of economies of scale.

This recommendation is conditional on the size and complexity of the Tunnel operations remaining at their current levels. If the Authority's scope of operations significantly increases (e.g., by adding such facilities as Tobin Bridge, Third Harbor Tunnel, or the Central Artery), the expanded size, location, and similarity of operations may justify a "cross harbor" or "metropolitan tunnel and bridge" unit at that time. A unit of this magnitude could potentially be responsible for the Prudential Center Passageway and all MassPike facilities east of the Prudential Center Passageway.

B. Maintenance Division

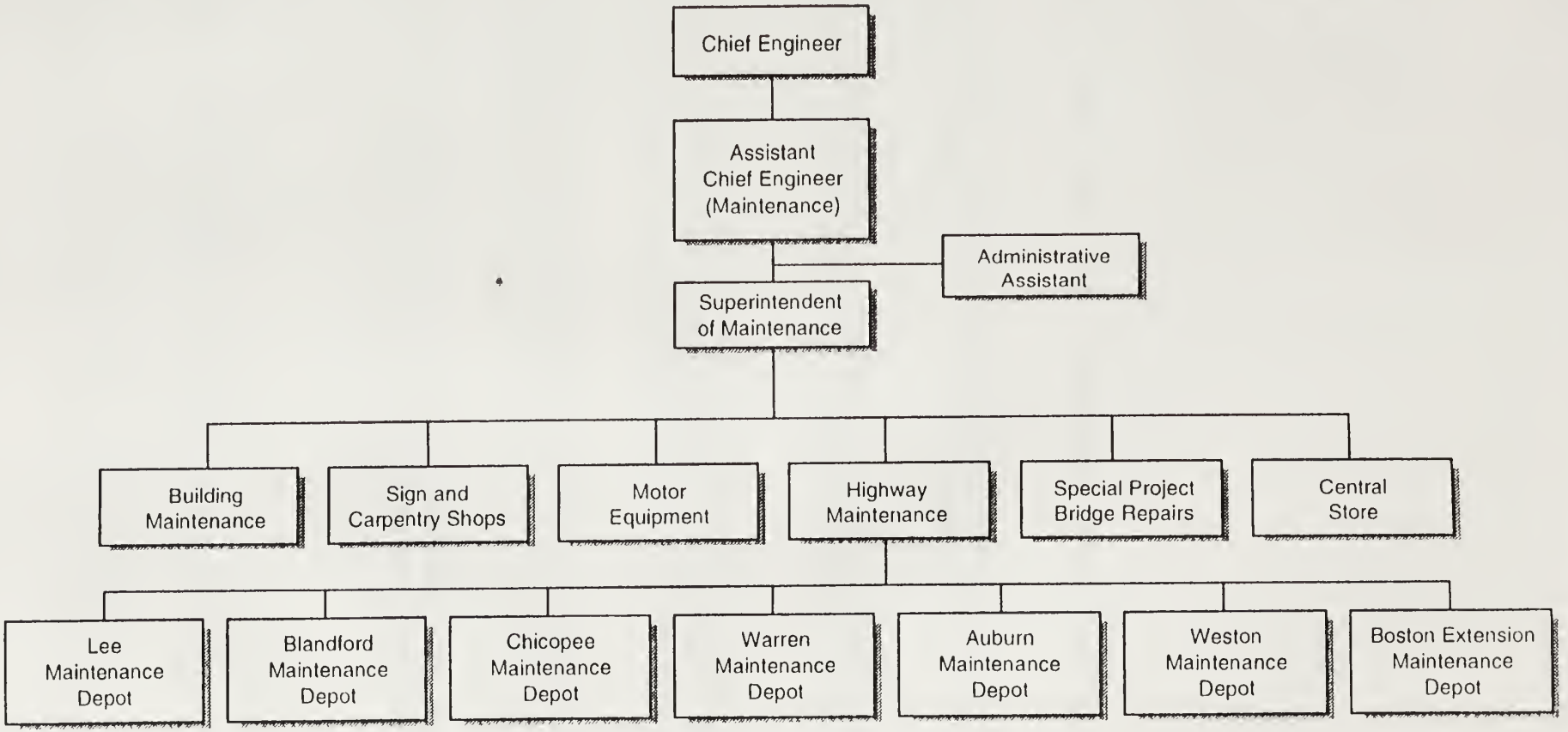
Finding. The Maintenance Division currently exhibits a relatively flat organizational structure based on numerous functional and geographic units, as shown in Exhibit 4-7. The Assistant Chief Engineer (Maintenance) has the following six units within his span of control:

- Highway Maintenance

Maintenance Division

EXHIBIT 4-7

CURRENT ORGANIZATIONAL STRUCTURE



- Building Maintenance
- Sign and Carpenter Shop
- Motor Equipment
- Bridge Maintenance and Special Projects
- Central Stores

The Authority has plans to reorganize this division into three functionally related units as depicted in Exhibit 4-8.

Within the Highway Maintenance units, the Maintenance Depot Foreman and Maintenance Supervisors appear to have overlapping responsibilities for directing the daily maintenance of the highway and bridges.

The division has experienced difficulty in providing satisfactory cost-effective janitorial services using Authority staff. Several organizational options have been tried that have not been effective.

Recommendation. The planned maintenance reorganization appears appropriate and conceptually well conceived. It should improve service delivery and accountability. The reorganization should proceed as planned with the inclusion of a Tunnel's maintenance unit, as noted in prior recommendations.

The Authority should consider eliminating the supervisory redundancies and associated levels of management within Highway Maintenance by the consolidation of Maintenance Depot Foreman and Maintenance Depot Supervisors positions.

The Authority should complete ongoing analyses to assess the benefits and costs of using contracted janitorial services for cleaning its facilities. Many government agencies use contracted janitorial services and have found them to be cost-effective.

C. Construction Division

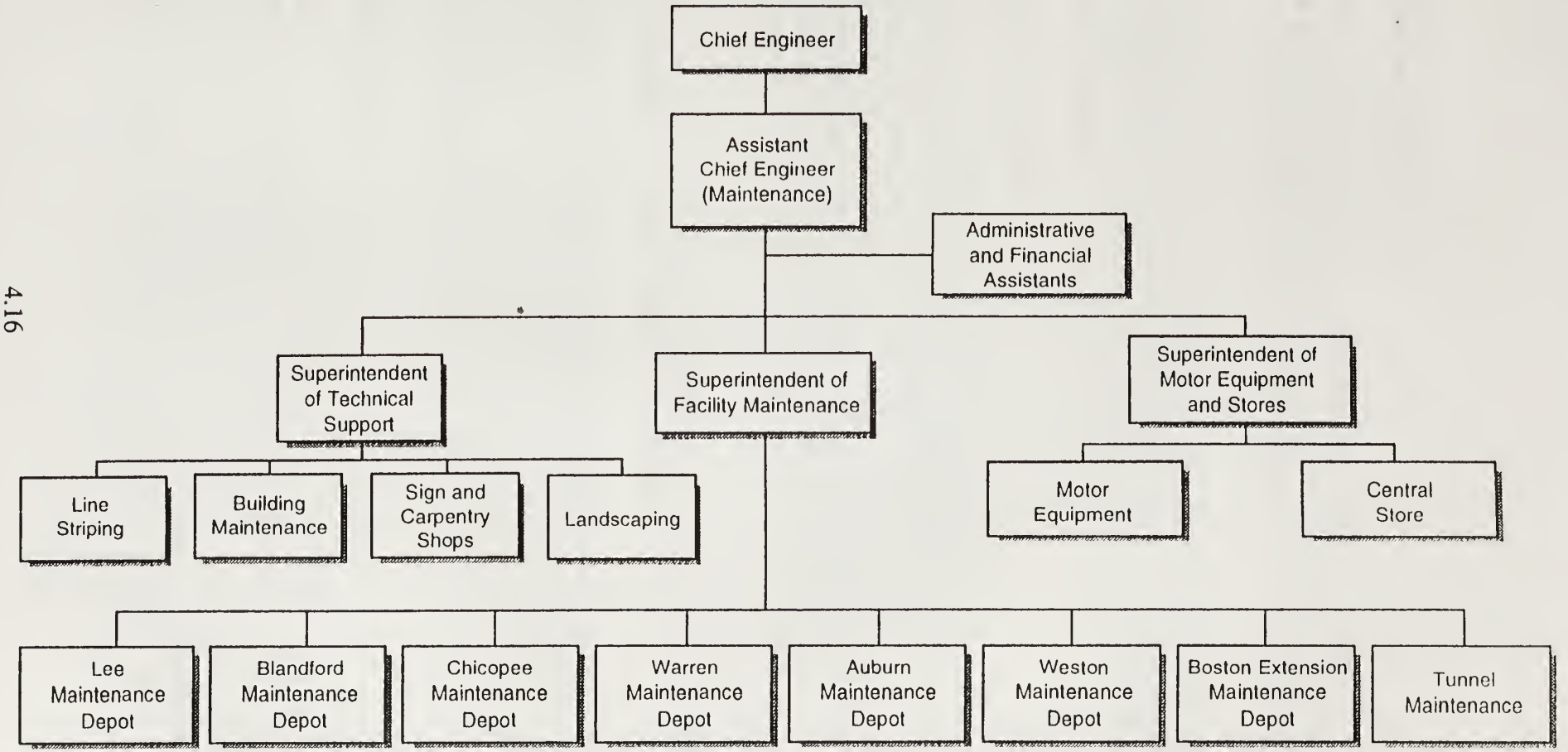
Finding. Similar to the Highway Maintenance Division, the Construction Division supervisor positions appear to have overlapping responsibilities and unclear distinctions between Division Engineer and Assistant Division Engineer positions.

Recommendation. The Authority should consider consolidating Construction Division Engineer and Assistant Division Engineer positions to reduce costs and eliminate unnecessary management levels.

Maintenance Division

EXHIBIT 4-8

PROPOSED ORGANIZATIONAL STRUCTURE



D. Toll Collection Division

Finding. Within the Toll Collection Division, the Toll Collection Assistant Superintendent and the Section Supervisor have overlapping responsibilities to supervise and plan toll collection activities within the three geographic divisions of the toll collection function.

Recommendation. The Authority should consider consolidating Toll Collection Division's Assistant Superintendent and Section Supervisor positions. This would eliminate overlapping responsibilities and lower the overall personnel cost for the Toll Collection Division by reducing the number of senior supervisory personnel from 5 to 3.

E. Patron Services Division

Finding. The Authority's Patron Services Division provides emergency patrol services to Turnpike users and also is responsible for inspecting the service areas for compliance with lease and service provisions. Although the emergency patrol services appear to be effective in serving motorists with disabled vehicles, the services are costly to provide. There are 19 staff that provide emergency patrol services and the Authority annually acquires vans to operate the service. There are sizable fuel and vehicle maintenance costs associated with this service that are included in the Maintenance Division's budget.

The division has four staff assigned full-time to inspect service areas along the Turnpike. This appears to be an excessive number of staff for this function.

Recommendation. The Authority should reassess the levels of emergency service it operates and determine if a mix of Authority and private service providers could more cost-effectively provide such services. The Authority should also assess options for cross-training maintenance staff to provide service area inspection services as well as carry out their existing duties. This potentially could reduce the four staff currently assigned full-time to the inspection function.

F. State Police Division

Finding. The Authority is bound by agreement to have State Police provide traffic management services at its construction sites. Troopers (not necessarily assigned to Troop E) volunteer for the details to supplement their existing pay. Payment for their services comes from Authority capital funds and not Troop E operations. In most states, traffic management services at construction sites are the responsibility of construction contractors or agency construction highway staff, not state police. Authority traffic management costs are significant in that state police perform work at hourly rates that are

substantially higher than for construction contractor staff or nonuniformed Authority maintenance staff.

Recommendation. Traffic management services at construction sites should be provided by contractors or maintenance staff. This would lower the cost of the services provided and in most cases not significantly diminish its effectiveness. State police can be used to supplement "flagpersons" at appropriate times and locations where safety concerns are high (e.g., blasting areas, tunnel traffic rerouting).

G. Environmental Engineering

Finding. The Authority, like other public and private organizations, must comply with more comprehensive and complex environmental regulations mandated by EPA and Commonwealth agencies. To address this situation, Operations has increased its technical expertise in recent years by hiring an environmental engineer. The Authority continues to experience an increasing demand to address environmental concerns and regulations in virtually all facets of its work. To address this increasing need, the 1992 budgets calls for adding an entry-level environmental engineer.

Recommendation. While we agree that environmental engineering capabilities need to be strengthened, our assessment indicates that the Authority also needs a senior environmental engineer to direct, manage, and administer this increasingly important activity and related staff functions.

Development and Planning

The Development and Planning Department was formed in 1990 and expanded the role of the former Real Estate Department. Its responsibilities include tourism services, community relations, license and lease administration, development planning for air rights and real estate assets, and facility planning for support services and customer services.

A. Development and Planning Units

Finding. The Development and Planning Department has numerous studies under way, including: a complete property inventory for the Authority, a lease and license inventory, air rights planning feasibility study, preparation of property disposition guidelines, service area assessments, lease and license renegotiations, park and ride facility studies, a truck usage pattern study, and a facilities planning study. The Department's work plans for conducting these studies appear sound.

The Department clearly has a large set of ambitious projects and goals, especially given its limited resources of four professional staff. The professional staff is being pulled in numerous directions to oversee its ambitious work load.

The Department currently contracts with architectural, engineering, and related firms to assist in many of these studies. It lacks in-house architectural design skills that may be needed to support its rapidly growing real estate, service area, and facilities development activities.

Recommendation. The number and intensity of demands on the Department are considerable. As its many projects get closer to implementation. The Authority needs to set priorities so that staff will have clear direction regarding which projects/program to pursue and how to allocate available resources among them.

In the future as its many projects and studies move toward implementation, the Department may require architecture and design support capabilities to augment the planning and development skills it has now. The Authority should anticipate the need for these skills in as little as two years.

B. Transportation Planning Function

Finding. The Authority undertakes many transportation planning studies including: preparing traffic and revenue forecasts; planning travel demand/management facilities and programs (e.g., park and ride facilities, HOV facilities), and site-specific traffic generation studies. The new Clean Air Act and Federal Transportation Act are likely to increase the need for such skills. The Authority currently relies on consultants for such services. Techniques and assumptions used in the studies are not consistently followed and the Authority lacks the transportation planning expertise to design and manage such studies.

Recommendation. The Authority needs to acquire a transportation planning function that supports the capital financing, real estate development, and operations and project development functions of the Authority. Given the breadth of its role and responsibilities, the transportation planning function might be established as a specific unit within the Development and Planning Department. This new unit should have a transportation planner with approximately 3 to 5 years' experience and should interact with and support other Authority units.

Administration

There are four functions currently within Administration: (1) affirmative action and equal opportunity, (2) human resources, (3) board services, and (4) labor relations.

A. Board Services

Finding. The Board meets formally--usually every two weeks--in execution of its duties. The Chairman of the Board also serves as the Chief Executive Officer (CEO) of the Authority. The Administration Department provides administrative support to the Board.

The Board Services function is a critical staff function provided by this department. This function demands high-level staff involvement and is a major responsibility of the Director of Administration. This has limited the Administration Department's ability to perform more traditional roles associated with administration such as support services, purchasing, and information system services.

Recommendation. As the management information systems and associated operating procedures of the Authority are strengthened over time in accordance with its strategic plan for information technology, the Administration Department will be able to absorb other administrative functions such as support services, information system services, and purchasing.

B. Affirmative Action

Finding. While the Affirmative Action Officer reports directly to the Chairman by law, the position's day-to-day activities are overseen by the Director of Administration, and hence, the Director has significant administrative responsibility for the function. Within the traditional Personnel Division, the Authority maintains a Women Business Enterprise (WBE) and Minority Business Enterprise (MBE) unit. This unit and the Affirmative Action Office have related program responsibilities, which are currently fragmented due to their separate organizational arrangement.

Recommendation. The WBE/MBE unit should be consolidated with the affirmative action/equal employment opportunity program function as they are logically and functionally related.

Secretary/Treasurer

The Secretary/Treasurer Department encompasses accounting, budgeting, capital finance, support services, information system services (ISS), retirement, insurance, and internal audit functions.

A. Internal Audit

Finding. The Internal Audit function is an "auditing" function reporting directly to the Deputy Secretary/Treasurer, although on substantive matters it reports directly to Chairman. The function of internal auditing today is different, broader, and more operational than in former years. It encompasses the plan of organization and all methods

and procedures adopted by management for an organization to safeguard its assets, check the accuracy and reliability of its accounting data, promote operational efficiency, and encourage adherence to prescribed managerial policies as well as with laws and regulations.

Supportive actions have already been taken by the Secretary/Treasurer to foster the evolution of the Authority's internal audit function, consistent with the directions described above.

Recommendation. We recommend that the existing informal reporting relationship to the Board be formalized through a charter or policy statement. In the near term, the Authority's internal audit organization may still require the continued attention of senior executive staff to direct and nurture its evolution. In the future, the internal audit function should play a key role to ensure that the Authority's overall organization is promoting operational efficiency and adhering to policy, laws, and regulations. This can be accomplished by ultimately placing the internal audit function within a separate organizational unit, reporting directly to the Board, including the Chairman.

B. Support Services Division

Finding. The Support Services Division encompasses the motor pool and print shop units. As with other areas of the Authority, the products and services in these areas are being examined to see whether the Authority or a contractor can best deliver the product or service most cost effectively. The Authority currently contracts out some printing functions.

Recommendation. These services are not functionally related to the other Secretary/Treasurer functions and the Authority should consider placing the Support Services Division within the Administration Department. Privatization studies of products and services where competition exists (e.g., printing) should be continued and ongoing cost-effectiveness studies be completed by the Secretary/Treasurer before support services responsibilities are assumed by the Administration Department.

C. First Deputy Secretary/Treasurer

Finding. The First Deputy Secretary/Treasurer is responsible for the capital finance, purchasing, and budgeting functions within the Authority. The current operating budget process has a one-year time horizon. The Authority has retained a financial advisor to assist in developing a capital financing plan and this process is progressing. However, at present capital financing strategies and capital spending plans lack full integration.

Recommendation. The Authority should develop an integrated (tunnel and Turnpike) business planning process (3- to 5-year forecast horizon) that contains linkages among the following elements:

- Goals and objectives for the forecast period

- Performance objectives and key initiatives by year
- Operating plan (revenue and expenditure budget and forecasts)
- Capital spending plan (annual capital spending plan and forecasts by fund)
- Capital plan (project-specific annual capital plan and forecasts)
- Financing strategy (annual financing plan and forecasts)

The Authority is evolving towards an integrated business planning model. We recommend that the Authority give this recommendation a top priority.

D. Information Systems Services Division

Finding. The Information Systems Services (ISS) Division reports to the Secretary/Treasurer. It is currently participating in an information technology strategic planning study. The findings and recommendations of this study are presented later in this section. Major hardware and software improvements have been recommended, particularly in the financial management functions of the Authority.

Recommendation. Typically, the ISS Division would be located in the Administration Department. However, given that (1) the ongoing information systems planning process is being led by the Secretary/Treasurer, (2) the most pressing applications initiatives are in the Secretary/Treasurer's units, and (3) the Administration Department currently with its commitments to the Board is not prepared at present to direct the information systems planning process and manage the ISS unit, it is recommended that the ISS Division remain under the Secretary/Treasurer until such time that the evolution of the organization allows it to be placed in the Administration Division.

Summary of Organizational Assessment

The major findings and recommendations of this section are summarized below:

- The Authority has implemented organizational and management changes in the past several years to improve its efficiency and effectiveness. This included reorganizing the Authority to reduce the number of managers reporting directly to the Chairman and to more effectively integrate and coordinate related functions in its Operations Department and its Secretary/Treasurer function.
- To promote accountability and performance, the Authority has developed a performance evaluation program for its executive staff which is guided by overall Authority goals and annual performance objectives. It has also implemented a comprehensive training program to enhance the technical and managerial skills of its staff.

- The Authority is about to complete a comprehensive strategic systems planning assessment that will recommend software and hardware to improve the management and operation of the Authority by effectively applying the state of the art technology.

- This assessment recommends several organizational changes to streamline the Authority and improve its effectiveness. These changes include: consolidating its Tunnel Division in other divisions of the Operations Department and consolidating the Authority's Affirmative Action and Equal Employment Opportunity functions in a single unit.

- Opportunities to streamline the Authority's staffing and reduce operating costs have been identified in the engineering, toll collection, and maintenance functions. Authority costs potentially could be reduced through privatizing its print shop, janitorial services, and potentially parts or all of its emergency patrol services program. Several of the options are currently under study by the Authority.

- The Authority has added important capabilities to meet mandated environmental requirements and other evolving Authority needs. These capabilities include: a greatly strengthened environmental engineering function and a new Development and Planning Department that is responsible for planning and developing the Authority's real estate and air rights assets to promote economic development and Authority revenues. The Authority has also strengthened its capital financing and budgeting functions and is developing a multiyear business planning process that relates Authority goals and key initiatives to its operating and capital budgets and its capital financing strategies.

- An important additional capability that the Authority should have is an experienced transportation planner to direct and oversee the many traffic, demand management, and site planning studies that the Authority conducts. This capability will be increasingly important given the requirements of the new Clean Air Act and the federal transportation act.

Exhibit 4-9 presents the recommended organizational structure for the Authority based on the above findings and recommendations.

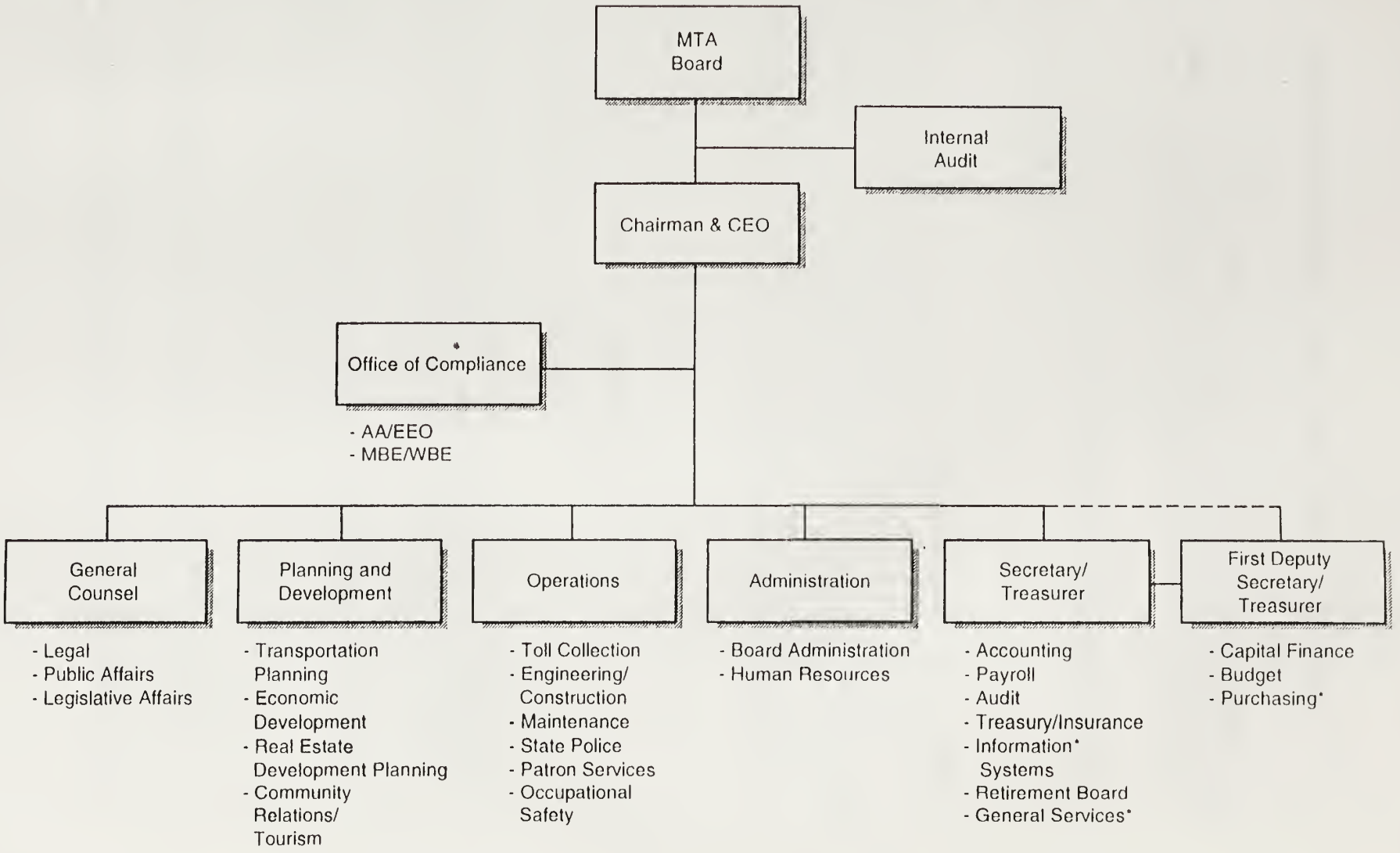
CAPITAL IMPROVEMENT PROGRAM

The Authority expends millions of dollars annually to rehabilitate, reconstruct, and improve the Turnpike, the Callahan and Sumner Tunnels, and supporting infrastructure (such as service areas and maintenance facilities), and to acquire equipment. This subsection of our report briefly describes and assesses the annual inspection and capital improvement programming processes used by the Authority.

Massachusetts Turnpike Authority

EXHIBIT 4-9

PROPOSED ORGANIZATIONAL STRUCTURE



* These functions should be shifted to Administration in the future when strengthened/new automated management systems are implemented to facilitate management by the department.

Overview of Authority's Annual Inspection and Capital Improvement Programming Processes

Authority bond covenants require annual inspections of the Turnpike and the Tunnels by the general consultants for these facilities. The Authority's general consultants include Howard Needles Tammen and Bergendoff (HNTB) for the Turnpike, and the joint venture team of Sverdrup/Parsons Brinckerhoff (S/PB) for the Tunnels.

An overview of the annual inspection process and the improvement prioritization process for the Turnpike and Tunnels follows.

Turnpike

HNTB has served as the Turnpike's general consultant since its inception. HNTB, which also serves as a general consultant for other turnpikes, utilizes established procedures to visually inspect the Turnpike. Its inspection is under the direction of a professional engineer. The inspection covers the Turnpike's roadways (e.g., pavement, slide slopes, and back slopes, and guardrail), roadway drainage, metal bin walls and concrete retaining walls, bridges, interchanges, maintenance areas, police barracks, service areas, lighting, pump houses, communications, meter stations, fan rooms, the Prudential Center Passageway, and sign supports.

Two trained crews conduct the annual inspection:

- Structural crew under the direction of a bridge engineer
- Civil crew under the direction of a civil engineer

The 1990 annual inspection also included architects and mechanical engineering specialists to provide input to the Authority's Turnpike capital facilities needs studies. The fields inspection reports are reviewed by the project engineer for quality assurance. Authority engineers also review such reports for consistency with their knowledge of field conditions.

The bridge inspections are conducted in accordance with FHWA bridge inspection and reporting procedures that are also used by Massachusetts DPW.

The Authority supplements the general consultants annual inspection two ways:

- Every five years an underwater bridge inspection is performed by a consultant specializing in such works
- Half of its bridges are also inspected annually by a team of Authority staff certified as bridge inspectors

The Turnpike's general consultant issues an annual inspection report. The report describes the inspection process, details the ratings of different components of the Turnpike, and identifies and prioritizes rehabilitation and reconstruction improvements.

The criteria used to rate and prioritize required repairs are:

- C - Under repair by contract
- R - Under repair by maintenance
- N - Not applicable
- 9 - New condition
- 8 - Good condition, no repairs needed
- 7 - Generally good condition, potential exists for minor maintenance
- 6 - Fair condition, potential exists for major maintenance
- 5 - Generally fair condition, potential exists for minor rehabilitation
- 4 - Marginal condition, potential exists for major rehabilitation
- 3 - Poor condition, repair or rehabilitation required immediately
- 2 - Critical condition, the need for rehabilitation is urgent; facility should be closed until the indicated repair is complete
- 1 - Critical condition, facility is closed; study should determine the feasibility for repair
- 0 - Critical condition, facility is closed and is beyond repair

Repairs rated between 0 and 4 are recommended for rehabilitation. In the 1991 annual inspection there were no repairs rated 2 or below. However, recommended repairs identified in the 1991 inspection included:

- 137 bridges
- 13 miles of pavement
- 15 miles of guardrail

These facilities had inspection ratings of 3 or 4, which indicate marginal or poor conditions. The 137 bridges needing construction or rehabilitation represent more than 50 percent of the bridges along the Turnpike.

The annual inspection program has provided input to a comprehensive capital needs study for the Turnpike. In 1989, the Authority adopted a 10-year Critical Needs Report that identified $603 million (in 1989 dollars) in required turnpike reconstruction and improvements. This program includes safety rehabilitation and reconstruction projects as well as traffic management projects such as the construction of high-occupancy-vehicle (HOV) toll lanes, car pools, park and ride lots, the acquisition of AVI toll collection equipment, projects to maintain Turnpike facilities in safe and functional condition, and projects to promote economic development (e.g., Route 146 interchange). The Authority has recently announced a plan to accelerate its reconstruction and improvement program to meet, in a timely and prudent fashion, the safety, legal, policy, and environmental compliance demands confronting the Authority.

Tunnels

Sverdrup/Parsons Brinckerhoff has developed and utilized a comprehensive tunnel inspection manual to guide the annual visual inspection of the tunnels. The inspection is directed by trained professional engineers from the joint venture. The inspection covers the structural elements, mechanical systems, electrical systems, and communication systems for:

- Sumner and Callahan Tunnels
- All ventilation buildings for both tunnels
- Tunnel approaches, including the East Boston toll plaza and the Boston portal area
- Tunnel service buildings

The bulk of the inspection was carried out by six crews. Each crew typically consisted of a lead engineer and a technician. Four structural crews inspected the tunnels and two of these crews also inspected the service and administration buildings. The General Consultants also utilized one mechanical crew and one electrical crew for the inspection. The crews were under the direction of project engineers, all of whom were professional engineers in the applicable specialization (e.g., structural, mechanical, or electrical engineering). The crews use automated hand-held data collectors to record their inspection ratings. This facilitates the inspection process and provides documentation.

During the inspection, quality control reviews were regularly performed by a senior member of the S/PB team by verifying the data collected by performing a field check of the data.

The Authority's engineer and staff review the general consultant inventory for consistency with their knowledge of the condition of the Tunnels.

The tunnel general consultant issues an annual inspection report that describes the inspection methods used, details the ratings and problems found in the annual inspection, and recommends and prioritizes rehabilitation and reconstruction improvements. Recommendations and priorities are established using the following rating system:

- I - Immediate (repairs to be conducted within 90 days)
- P1 - Repairs needed within one year
- P2 - Repairs needed within two years
- P3 - Repairs needed within three years
- R - Routine (repairs to be conducted within three to five years, or earlier if convenient)
- P4 - Repair routine in nature, not necessary for system function
- P5 - Routine tasks such as normal maintenance and monitoring
- N - No work required

The executive summary and body of the annual inspection report document the recommended improvements by priority category.

The Authority's $47 million capital improvement program for the Tunnels, which encompasses only those elements of its comprehensive program deemed essential, is documented in the offering statement for the 1990 tunnel financing.

Assessment of Capital Improvement Programming Process

In accordance with its bond covenants, the Authority conducts a rigorous annual inspection of its Turnpike and Tunnel facilities to identify needed repairs.

Each inspection process is rigorously managed, conducted, and documented to meet the bond covenant's objectives to properly maintain and rehabilitate the Turnpike and Tunnel facilities and to operate these facilities safely and in a financially sound manner. Thorough documentation is produced that facilitates the use of annual inspection reports by Authority engineers and management and allows scrutiny of the findings of the inspection results and priority recommendations. The inspection and rating processes appear to provide comprehensive and consistent inspection findings for input to the Authority's capital improvement and maintenance management programs.

The Authority, in conjunction with HNTB, has conducted in-depth critical needs studies for the Turnpike. The assessment processes used in these studies appear sound. However, it should be noted that capital improvement programming priority-setting processes are based on criteria and factors that build upon agency policies and professional judgment. Such policies and judgment appear to be sound, but other perspectives will inevitably be voiced that the Authority is investing too much or too little in the Turnpike and Tunnels.

Section 2 of this study indicates that both the Turnpike and Tunnels have significant maintenance and rehabilitation requirements. Section 3 demonstrates that the Authority's capital improvement program is similar in scale to those of several peer authorities.

FINANCIAL STRUCTURE

Overview

The Massachusetts Turnpike Authority was created with the user-pay concept where tolls from users of the services finance the construction, repair, and operation of the Turnpike facilities--with the exception of a half-million-dollar start-up loan in 1952 from the Commonwealth which was repaid in full in 1954--no state or federal revenues have ever been received by the Massachusetts Turnpike Authority.

In order to finance the construction and reconstruction of its facilities, the Authority was empowered to issue revenue bonds--bonds secured wholly by the pledge of its toll revenue.

The Authority also generates revenues from concession operations (fuel and food), tickets issued on the Authority's facilities, and interest income. There is no other pledge of federal or state revenues or taxes. This is in contrast to the use of limited revenue bonds to help finance toll facilities in several other states. Limited revenue bonds are issued under a pledge of support from another source of revenue, but do not carry any further guarantee of full faith and credit of the government.

New York State Thruway used limited revenue bonds in its initial construction. Approximately half the bonds necessary for its construction were backed by tolls and the full faith and credit of the State of New York. Selected other toll facilities in Florida, Oklahoma, Kentucky, and Delaware also used limited revenue bonds for financing.

The Authority's financial structure is prescribed by its revenue bond covenants and trust agreements. Trust agreements are legal contracts between the bondholders and the Authority which stipulate, in part, that all proceeds of sold bonds are placed in a construction fund to be expended, under the supervision of the consulting engineers, for only those purposes for which the bonds were issued. Trust agreements also prescribe the administration and flow of toll-based funds to pay for current operating costs, bond

reserves, bond interest, replacement reserve (monies for rehabilitation of assets), and bond redemption.

There are separate trust agreements for the Turnpike and Tunnel facilities.

Key features of the trust agreements include:

- Construction funds are designated exclusively for particular projects as stated on the revenue bond documents. Turnpike and Tunnel bond proceeds are administered and require the respective consulting engineers to certify that the use of funds is proper.

- Turnpike and Tunnel revenues are pledged individually and administered separately. The facilities cannot legally cross-subsidize each other.

- The current-year operating budgets for the Turnpike and Tunnels must not be in excess of those recommended by the respective Consulting Engineers (the Turnpike and Tunnels have independent consulting firms retained as consulting engineers). The current operating budget is the first "use" of toll revenues.

- Required bond repayments and interest are the second use of toll revenues.

- The third priority on the revenues is funding a replacement reserve for repairs or to construct temporary substitute facilities in order to maintain the flow of traffic and toll revenues. The Authority's replacement reserve represents, in effect, its construction budget since it must fund rehabilitation and replacement projects on a pay-as-you-go basis. The amount and purpose of funds expended from this account must be certified by the respective consulting engineers and Chief Engineer of the Authority.

- Remaining Turnpike funds (after accounting for the current budget, principal and interest payments on outstanding bonds, and replacement reserve requirements) are required under Turnpike agreements to be applied to bond sinking funds. Remaining Tunnel funds are deposited to the Tunnel general account and are available for required distributions, per the Tunnel trust agreement, in the next fiscal year.

Assessment

The key factors of the financial structure of the Authority are:

- The concept of a user pay system, where only users pay and they pay proportional to their use

- Utilization of revenue bond proceeds to finance the immediate need for funds to build/repair toll facilities that are expected to generate a steady stream of revenue equal to or greater than the bond proceeds and associated interest payments

- Trust agreements that demand separate administration of funds by facilities within the same transportation network and in the case of the Turnpike trust agreement, prescribed provisions for earlier redemption of bonds without regard for existing economic conditions or future capital requirements

The user pay concept and the issuing of revenue bonds have facilitated the construction, repair, and operation of the Turnpike and Tunnels without taxpayer money.

The trust agreements have served to attract and assure bondholders that principal and interest payments will be made. This may account for rating agency views that the Authority is a sound investment with little risk.

Even with the capital program critical needs study completed in 1989 and the Authority's recognizing that it would require an additional $603 million over the next 10 years, the management of the Authority was required in 1990 by the Turnpike trust agreement to redeem outstanding bonds including parts of the 1986 issue that have a maturity date of 2025. However, the current Turnpike trust agreement is restrictive and does not provide the Authority with much flexibility, which is essential if it is to meet the demands of its reconstruction and improvement program.

Current economic conditions and relatively high interest rates on the tunnel bonds combined with a relatively small amount of outstanding debt on the Turnpike issues creates a window of opportunity for the Authority to refund existing issues.

INFORMATION SYSTEMS ASSESSMENT FOR THE AUTHORITY

Authority senior management has recognized the importance of high-quality internal information systems in meeting the key business challenges faced by the organization both today and in the foreseeable future. Information which is accurate, readily accessible, timely, and at the appropriate level of detail is essential to making sound management decisions. The management team has also recognized that the current portfolio of information systems, which have evolved over the last 10 to 15 years, does not provide adequate information processing and analysis facilities to support management decision making in the fast paced business environment of the 1990s.

In October 1991, the Authority retained the consulting firm of Coopers & Lybrand to conduct an information systems needs assessment and formulate a 3- to 5-year strategic plan for information technology. The information technology strategic plan makes recommendations in four key areas which address the organization's ability to manage its financial status, design and manage construction and engineering projects, and utilize spatial information to appropriately manage maintenance, safety, and service across the physical transportation network.

The four areas, with their project and strategy recommendations are:

- **Application software.** This refers to the portfolio of business and engineering software needed to support the major business functions of the Authority. These recommendations were made following Coopers & Lybrand's definition of the business requirements for information, based on the way the Authority does business today, plus changes that can be anticipated given the strategic direction and long-range plans of the Authority:

  Replace the set of antiquated applications systems which are most difficult to maintain and evolve. These systems are the General Ledger, Accounts Receivable, Cash Disbursements, Payroll, and Time and Attendance Recording.

  Retain or enhance the Budget Preparation, Toll Collection, Toll Audit, and Fuel Management System, which do closely fit today's business requirements.

  Perform a detail analysis of the fleet management and equipment/supplies inventory systems, in order to determine whether they have an appropriate fit to business requirements. Then, either implement them fully or integrate them with the replacement financial and operational systems.

  Special attention was given to two applications which support areas unique to the Authority. The toll collection and toll audit information systems are relatively new and provide a good fit to business requirements of the organization. The recommendation is to reengineer the work process to reduce the time required to audit toll revenue. Spatial information systems which can graphically display spatially oriented information, such as maps and engineering drawings, are of critical importance to the MTA because of its role in managing safety, service, and physical maintenance of large infrastructure systems such as computer-aided design and geographic information systems. Adding these systems to the organization's application portfolio should be one of the early projects.

- **Hardware and data communications architecture.** This refers to the design of the computing platforms, networks, and facilities needed to support the application software portfolio.

  MTA needs to replace its midframe computing environment in the next few years. Unisys, the hardware vendor which supplies the Sperry System/80 (financial systems) and Burroughs V-310 (toll systems), has announced that it will drop these systems from technical support in, or shortly after, the year 2000. As a result, MTA will need to plan to migrate to replacement hardware by the year 1998, to avoid the risk of a significant degradation in service leading up to the vendor's deadline. In addition, Unisys has also announced that the Unisys 5055 Unix System (fleet and inventory systems), will be dropped from support in 1996. That means the organization must also migrate to new hardware for Unix applications by approximately 1994.

The end-user computing facilities, which the organization has developed over the last few years, provides the foundation to develop a client/server network for ease of user access and modular application development.

MTA will need to expand its data communication facilities in order to implement the client/server architecture and support the important business objective of integrating decision processes across departments within the organization. A communication backbone will be needed to link key computing facilities in East Boston, Park Plaza, Beacon Park, Weston, Westfield, various maintenance depots, and toll plazas.

An important near-term project in the five-year strategic plan will be to do a detail design of the communications network, integrating the requirements of voice and data communications.

- **Data and data management**. This defines a model for the types of data that should be stored and utilized by the organization's application software and the data base software needed to manage that data.

  MTA currently stores a wide variety of data in a combination of manual and automated forms throughout the organization. Each information system has its own set of files and no data base management technology is currently employed. This situation makes it difficult for information systems users to assemble information that spans across systems or to utilize modern ad hoc reporting and analysis tools.

  In the future, MTA must meet the challenge of managing data as an important organizational asset. To accomplish this, the technical organization should embark on putting together an enterprisewide data management function that will include developing formal data models for the organization and establishing a formal data administration function. MTA should also select and implement the appropriate data base environment, as opposed to the current application-specific flat file environment.

- **MIS organization and management**. A description of the human resource requirements, skill sets, and IT management practices that should be in place to properly manage the computing environment.

  MTA's information systems environment is supported by a small MIS organization, supporting midframe, and end-user computing environments. The focus of the current MIS organization for some years has been the maintenance and incremental enhancement of the major financial and toll midframe applications. The technical staff is experienced in the aspects of COBOL programming, systems analysis, and project management that are required for this mission.

  As the organization moves forward to modernize its application portfolio, replace its outdated hardware architecture, and establish enterprisewide data management

capabilities, a number of additional skill sets will be required. These skills include, among others, system design, project management, and capacity and configuration management capabilities. MTA must plan carefully to acquire the required skills through training of existing staff, acquisition of new staff in key positions, and the use of external consultants.

The recommendation also includes the establishment of an MIS Steering Committee and the establishment of a formal structure for project management.

STUDY CONCLUSIONS

The Authority compares favorably with major toll roads/turnpikes in New Jersey, New York, Ohio, and Pennsylvania in terms of staffing levels, work load measures, and cost indicators evaluated in this study. The Authority has achieved an outstanding safety record in comparison with other roads in Massachusetts and the nation and other major toll roads. Since the opening of the Turnpike, the Authority has kept its toll increases well below price increases for other goods and services, as measured by the Consumer Price Index between 1954 and 1991. Further, tolls for the Callahan and Sumner Tunnels are among the lowest tunnel and bridge tolls in the nation. These achievements are significant.

In accordance with its bond covenants, the Authority conducts a rigorous annual inspection of its Turnpike and Tunnel facilities to identify needed repairs. The Authority has conducted in-depth critical needs studies for the Turnpike that build extensively on these annual inspections. The assessment processes used in the critical needs studies appear sound and the recommended capital program prudent.

The Authority's commitment to improve its efficiency and effectiveness and maintain the safety and reliability of its transportation system is demonstrated by major organizational, operational, engineering, information system, development and planning, and capital financing improvements and programs initiated and implemented in the last several years. To reinforce such improvements and to help position the Authority to meet evolving future requirements and challenges, this study recommends additional staff-level management and operational changes.

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